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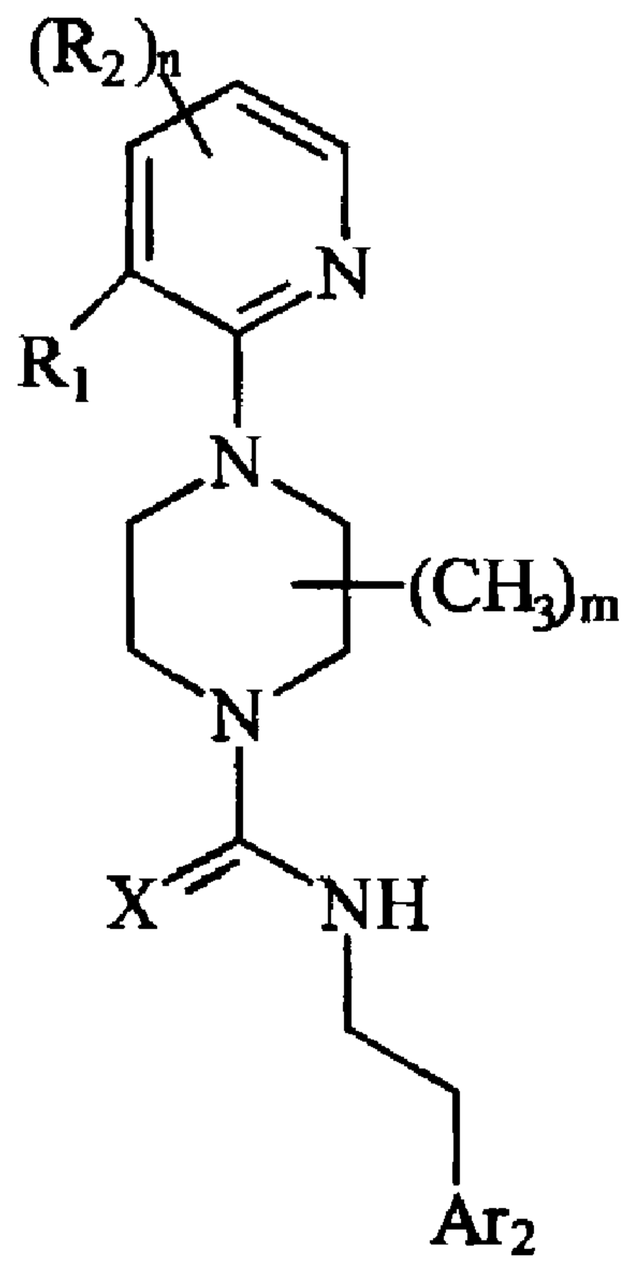
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(54) Titre : COMPOSES PYRIDYLE 2,3-SUBSTITUES UTILES DANS LE TRAITEMENT DE LA DOULEUR
(54) Title: 2,3-SUBSTITUTED PRYIDL COMPOUNDS USEFUL FOR TREATING PAIN



(I)

(57) Abrégé/Abstract:
Compounds of formulae (I) and (II) where X is S or O and Ar_2, R_1, R_2, R_3, R_8, n, m, and t are disclosed herein, or a pharmaceutically acceptable salt thereof (a "3-substituted Pyridyl Compound"), compositions comprising an effective amount of a 3-

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(57) Abrégé(suite)/Abstract(continued):
substituted Pyridyl Compound, and methods for treating or preventing pain, urinary incontinence, an ulcer, inflammatory-bowel disease, irritable-bowel syndrome, an addictive disorder, Parkinson's disease, parkinsonism, anxiety, epilepsy, stroke, a seizure, a pruritic condition, psychosis, a cognitive disorder, a memory deficit, restricted brain function, Huntington's chorea, amyotrophic lateral sclerosis, dementia, retinopathy, a muscle spasm, a migraine, vomiting, dyskinesia or depression in an animal comprising administering to an animal in need thereof an effective amount of a 3-substituted Pyridyl Compound are disclosed herein.

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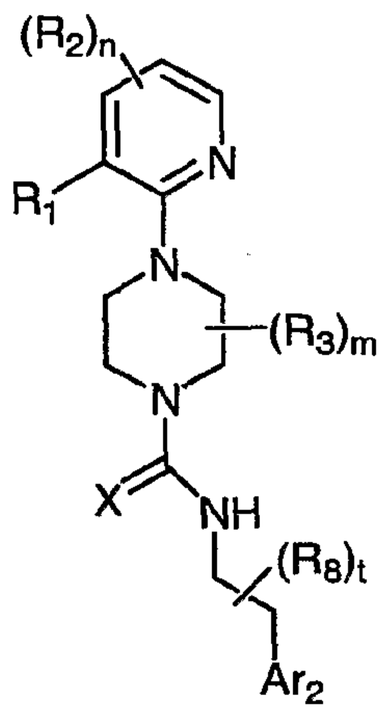
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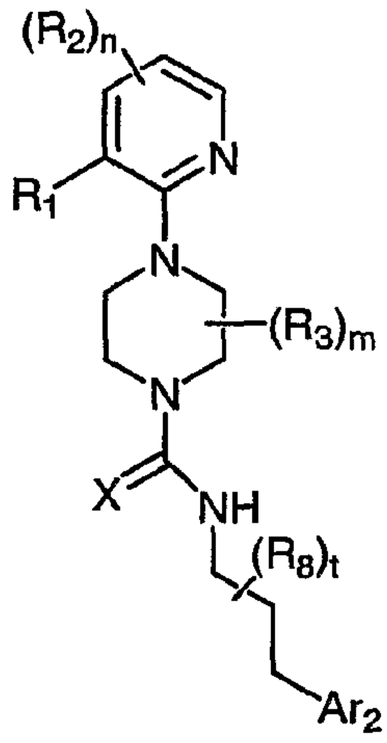
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(54) Title: THERAPEUTIC AGENTS USEFUL FOR TREATING PAIN



(I)



(II)

(57) Abstract: Compounds of formulae (I) and (II) where X is S or O and Ar_2, R_1, R_2, R_3, R_8, n, m, and t are disclosed herein, or a pharmaceutically acceptable salt thereof (a "3-substituted Pyridyl Compound"), compositions comprising an effective amount of a 3-substituted Pyridyl Compound, and methods for treating or preventing pain, urinary incontinence, an ulcer, inflammatory-bowel disease, irritable-bowel syndrome, an addictive disorder, Parkinson's disease, parkinsonism, anxiety, epilepsy, stroke, a seizure, a pruritic condition, psychosis, a cognitive disorder, a memory deficit, restricted brain function, Huntington's chorea, amyotrophic lateral sclerosis, dementia, retinopathy, a muscle spasm, a migraine, vomiting, dyskinesia or depression in an animal comprising administering to an animal in need thereof an effective amount of a 3-substituted Pyridyl Compound are disclosed herein.

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2, 3,-SUBSTITUTED PRYIDL COMPOUNDS USEFUL FOR TREATING PAIN

1. FIELD OF THE INVENTION

The present invention relates to 3-substituted Pyridyl Compounds, compositions comprising an effective amount of a 3-substituted Pyridyl Compound and methods for treating or preventing a condition such as pain comprising administering to an animal in need thereof an effective amount of a 3-substituted Pyridyl Compound.

2. BACKGROUND OF THE INVENTION

Pain is the most common symptom for which patients seek medical advice and treatment. Pain can be acute or chronic. While acute pain is usually self-limited, chronic pain persists for 3 months or longer and can lead to significant changes in a patient's personality, lifestyle, functional ability and overall quality of life (K.M. Foley, *Pain, in Cecil Textbook of Medicine* 100-107 (J.C. Bennett and F. Plum eds., 20th ed. 1996)).

Moreover, chronic pain can be classified as either nociceptive or neuropathic. Nociceptive pain includes tissue injury-induced pain and inflammatory pain such as that associated with arthritis. Neuropathic pain is caused by damage to the peripheral or cental nervous system and is maintained by aberrant somatosensory processing. There is a large body of evidence relating activity at both Group I mGluRs (mGluR1 and mGluR5) (M.E. Fundytus, *CNS Drugs* 15:29-58 (2001)) and vanilloid receptors (VR1) (V. Di Marzo *et al.*, *Current Opinion in Neurobiology* 12:372-379 (2002)) to pain processing. Inhibiting mGluR1 or mGluR5 reduces pain, as shown by *in vivo* treatment with antibodies selective for either mGluR1 or mGluR5, where neuropathic pain in rats was attenuated (M.E. Fundytus *et al.*, *NeuroReport* 9:731-735 (1998)). It has also been shown that antisense oligonucleotide knockdown of mGluR1 alleviates both neuropathic and inflammatory pain (M.E. Fundytus *et al.*, *British Journal of Pharmacology* 132:354-367 (2001); M.E. Fundytus *et al.*, *Pharmacology, Biochemsitry & Behavior* 73:401-410 (2002)). Small molecule antagonists for mGluR5-attenuated pain in *in vivo* animal models are disclosed in, *e.g.*, K. Walker *et al.*, *Neuropharmacology* 40:1-9 (2000) and A. Dogrul *et al.*, *Neuroscience Letters* 292:115-118 (2000)).

Nociceptive pain has been traditionally managed by administering non-opioid analgesics, such as acetylsalicylic acid, choline magnesium trisalicylate, acetaminophen, ibuprofen, fenoprofen, diflusinal, and naproxen; or opioid analgesics, including morphine, hydromorphone, methadone, levorphanol, fentanyl, oxycodone, and oxymorphone. *Id.* In addition to the above-listed treatments, neuropathic pain, which can be difficult to treat, has also been treated with anti-epileptics (*e.g.*, gabapentin, carbamazepine, valproic acid, topiramate, phenytoin), NMDA antagonists (*e.g.*, ketamine, dextromethorphan), topical lidocaine (for post-herpetic neuralgia), and tricyclic antidepressants (*e.g.*, fluoxetine, sertraline and amitriptyline).

Pain has been traditionally managed by administering non-opioid analgesics, such as acetylsalicylic acid, choline magnesium trisalicylate, acetaminophen, ibuprofen, fenoprofen, diflusinal, and naproxen; or opioid analgesics, including morphine, hydromorphone, methadone, levorphanol, fentanyl, oxycodone, and oxymorphone. *Id.*

Urinary incontinence ("UI") is uncontrollable urination, generally caused by bladder-detrusor-muscle instability. UI affects people of all ages and levels of physical health, both in health care settings and in the community at large. Physiologic bladder contraction results in large part from acetylcholine-induced stimulation of post-ganglionic muscarinic-receptor sites on bladder smooth muscle. Treatments for UI include the administration of drugs having bladder-relaxant properties, which help to control bladder-detrusor-muscle overactivity. For example, anticholinergics such as propantheline bromide and glycopyrrolate, and combinations of smooth-muscle relaxants such as a combination of racemic oxybutynin and dicyclomine or an anticholinergic, have been used to treat UI (*See, e.g.*, A.J. Wein, *Urol. Clin. N. Am.* 22:557-577 (1995); Levin *et al.*, *J. Urol.* 128:396-398 (1982); Cooke *et al.*, *S. Afr. Med. J.* 63:3 (1983); R.K. Mirakhur *et al.*, *Anaesthesia* 38:1195-1204 (1983)). These drugs are not effective, however, in all patients having uninhibited bladder contractions. Administration of anticholinergic medications represent the mainstay of this type of treatment.

None of the existing commercial drug treatments for UI has achieved complete success in all classes of UI patients, nor has treatment occurred without significant adverse side effects. For example, drowsiness, dry mouth, constipation, blurred vision, headaches, tachycardia, and cardiac arrhythmia, which are related to the anticholinergic activity of traditional anti-UI drugs, can occur frequently and adversely affect patient compliance. Yet despite the prevalence of unwanted anticholinergic effects in many

patients, anticholinergic drugs are currently prescribed for patients having UI. *The Merck Manual of Medical Information* 631-634 (R. Berkow ed., 1997).

Ulcers are sores occurring where the lining of the digestive tract has been eroded by stomach acids or digestive juices. The sores are typically well-defined round or oval lesions primarily occurring in the stomach and duodenum. About 1 in 10 people develop an ulcer. Ulcers develop as a result of an imbalance between acid-secretory factors, also known as "aggressive factors," such as stomach acid, pepsin, and *Helicobacter pylori* infection, and local mucosal-protective factors, such as secretion of bicarbonate, mucus, and prostaglandins.

Treatment of ulcers typically involves reducing or inhibiting the aggressive factors. For example, antacids such as aluminum hydroxide, magnesium hydroxide, sodium bicarbonate, and calcium bicarbonate can be used to neutralize stomach acids. Antacids, however, can cause alkalosis, leading to nausea, headache, and weakness. Antacids can also interfere with the absorption of other drugs into the blood stream and cause diarrhea.

H_2 antagonists, such as cimetidine, ranitidine, famotidine, and nizatidine, are also used to treat ulcers. H_2 antagonists promote ulcer healing by reducing gastric acid and digestive-enzyme secretion elicited by histamine and other H_2 agonists in the stomach and duodenum. H_2 antagonists, however, can cause breast enlargement and impotence in men, mental changes (especially in the elderly), headache, dizziness, nausea, myalgia, diarrhea, rash, and fever.

H^+, K^+ - ATPase inhibitors such as omeprazole and lansoprazole are also used to treat ulcers. H^+, K^+ - ATPase inhibitors inhibit the production of enzymes used by the stomach to secrete acid. Side effects associated with H^+, K^+ - ATPase inhibitors include nausea, diarrhea, abdominal colic, headache, dizziness, somnolence, skin rashes, and transient elevations of plasma activities of aminotransferases.

Sucraflate is also used to treat ulcers. Sucraflate adheres to epithelial cells and is believed to form a protective coating at the base of an ulcer to promote healing. Sucraflate, however, can cause constipation, dry mouth, and interfere with the absorption of other drugs.

Antibiotics are used when *Helicobacter pylori* is the underlying cause of the ulcer. Often antibiotic therapy is coupled with the administration of bismuth compounds

such as bismuth subsalicylate and colloidal bismuth citrate. The bismuth compounds are believed to enhance secretion of mucous and HCO_3^-, inhibit pepsin activity, and act as an antibacterial against *H. pylori*. Ingestion of bismuth compounds, however, can lead to elevated plasma concentrations of Bi^{+3} and can interfere with the absorption of other drugs.

Prostaglandin analogues, such as misoprostal, inhibit secretion of acid and stimulate the secretion of mucous and bicarbonate and are also used to treat ulcers, especially ulcers in patients who require nonsteroidal anti-inflammatory drugs. Effective oral doses of prostaglandin analogues, however, can cause diarrhea and abdominal cramping. In addition, some prostaglandin analogues are abortifacients.

Carbenoxolone, a mineral corticoid, can also be used to treat ulcers. Carbenoxolone appears to alter the composition and quantity of mucous, thereby enhancing the mucosal barrier. Carbenoxolone, however, can lead to Na^+ and fluid retention, hypertension, hypokalemia, and impaired glucose tolerance.

Muscarinic cholinergic antagonists such as pirenzapine and telenzapine can also be used to reduce acid secretion and treat ulcers. Side effects of muscarinic cholinergic antagonists include dry mouth, blurred vision, and constipation. *The Merck Manual of Medical Information* 496-500 (R. Berkow ed., 1997) and *Goodman and Gilman's The Pharmacological Basis of Therapeutics* 901-915 (J. Hardman and L. Limbird eds., 9th ed. 1996).

Inflammatory-bowel disease ("IBD") is a chronic disorder in which the bowel becomes inflamed, often causing recurring abdominal cramps and diarrhea. The two types of IBD are Crohn's disease and ulcerative colitis.

Crohn's disease, which can include regional enteritis, granulomatous ileitis, and ileocolitis, is a chronic inflammation of the intestinal wall. Crohn's disease occurs equally in both sexes and is more common in Jews of eastern-European ancestry. Most cases of Crohn's disease begin before age 30 and the majority start between the ages of 14 and 24. The disease typically affects the full thickness of the intestinal wall. Generally the disease affects the lowest portion of the small intestine (ileum) and the large intestine, but can occur in any part of the digestive tract.

Early symptoms of Crohn's disease are chronic diarrhea, crampy abdominal pain, fever, loss of appetite, and weight loss. Complications associated with Crohn's disease

include the development of intestinal obstructions, abnormal connecting channels (fistulas), and abscesses. The risk of cancer of the large intestine is increased in people who have Crohn's disease. Often Crohn's disease is associated with other disorders such as gallstones, inadequate absorption of nutrients, amyloidosis, arthritis, episcleritis, aphthous stomatitis, erythema nodosum, pyoderma gangrenosum, ankylosing spondylitis, sacroilitis, uveitis, and primary sclerosing cholangitis. There is no known cure for Crohn's disease.

Cramps and diarrhea, side effects associated with Crohn's disease, can be relieved by anticholinergic drugs, diphenoxylate, loperamide, deodorized opium tincture, or codeine. Generally, the drug is taken orally before a meal.

Broad-spectrum antibiotics are often administered to treat the symptoms of Crohn's disease. The antibiotic metronidazole is often administered when the disease affects the large intestine or causes abscesses and fistulas around the anus. Long-term use of metronidazole, however, can damage nerves, resulting in pins-and-needles sensations in the arms and legs. Sulfasalazine and chemically related drugs can suppress mild inflammation, especially in the large intestine. These drugs, however, are less effective in sudden, severe flare-ups. Corticosteroids, such as prednisone, reduce fever and diarrhea and relieve abdominal pain and tenderness. Long-term corticosteroid therapy, however, invariably results in serious side effects such as high blood-sugar levels, increased risk of infection, osteoporosis, water retention, and fragility of the skin. Drugs such as azathioprine and mercaptourine can compromise the immune system and are often effective for Crohn's disease in patients that do not respond to other drugs. These drugs, however, usually need 3 to 6 months before they produce benefits and can cause serious side effects such as allergy, pancreatitis, and low white-blood-cell count.

When Crohn's disease causes the intestine to be obstructed or when abscesses or fistulas do not heal, surgery can be necessary to remove diseased sections of the intestine. Surgery, however, does not cure the disease, and inflammation tends to recur where the intestine is rejoined. In almost half of the cases a second operation is needed. *The Merck Manual of Medical Information* 528-530 (R. Berkow ed., 1997).

Ulcerative colitis is a chronic disease in which the large intestine becomes inflamed and ulcerated. leading to episodes of bloody diarrhea, abdominal cramps, and fever. Ulcerative colitis usually begins between ages 15 and 30; however, a small group

of people have their first attack between ages 50 and 70. Unlike Crohn's disease, ulcerative colitis never affects the small intestine and does not affect the full thickness of the intestine. The disease usually begins in the rectum and the sigmoid colon and eventually spreads partially or completely throughout the large intestine. The cause of ulcerative colitis is unknown.

Treatment of ulcerative colitis is directed to controlling inflammation, reducing symptoms, and replacing lost fluids and nutrients. Anticholinergic drugs and low doses of diphenoxylate or loperamide are administered for treating mild diarrhea. For more intense diarrhea higher doses of diphenoxylate or loperamide, or deodorized opium tincture or codeine are administered. Sulfasalazine, olsalazine, prednisone, or mesalamine can be used to reduce inflammation. Azathioprine and mercaptopurine have been used to maintain remissions in ulcerative-colitis patients who would otherwise need long-term corticosteroid treatment. In severe cases of ulcerative colitis the patient is hospitalized and given corticosteroids intravenously. People with severe rectal bleeding can require transfusions and intravenous fluids. If toxic colitis develops and treatments fail, surgery to remove the large intestine can be necessary. Non-emergency surgery can be performed if cancer is diagnosed, precancerous lesions are detected, or unremitting chronic disease would otherwise make the person an invalid or dependent on high doses of corticosteroids. Complete removal of the large intestine and rectum permanently cures ulcerative colitis. *The Merck Manual of Medical Information* 530-532 (R. Berkow ed., 1997) and *Goodman and Gilman's The Pharmacological Basis of Therapeutics* (J. Hardman and L. Limbird eds., 9th ed. 1996).

Irritable-bowel syndrome ("IBS") is a disorder of motility of the entire gastrointestinal tract, causing abdominal pain, constipation, and/or diarrhea. IBS affects three-times more women than men. In IBS stimuli such as stress, diet, drugs, hormones, or irritants can cause the gastrointestinal tract to contract abnormally. During an episode of IBS, contractions of the gastrointestinal tract become stronger and more frequent, resulting in the rapid transit of food and feces through the small intestine, often leading to diarrhea. Cramps result from the strong contractions of the large intestine and increased sensitivity of pain receptors in the large intestine.

There are two major types of IBS. The first type, spastic-colon type, is commonly triggered by eating, and usually produces periodic constipation and diarrhea with pain. Mucous often appears in the stool. The pain can come in bouts of continuous

dull aching pain or cramps, usually in the lower abdomen. The person suffering from spastic-colon type IBS can also experience bloating, gas, nausea, headache, fatigue, depression, anxiety, and difficulty concentrating. The second type of IBS usually produces painless diarrhea or constipation. The diarrhea can begin suddenly and with extreme urgency. Often the diarrhea occurs soon after a meal and can sometimes occur immediately upon awakening.

Treatment of IBS typically involves modification of an IBS-patient's diet. Often it is recommended that an IBS patient avoid beans, cabbage, sorbitol, and fructose. A low-fat, high-fiber diet can also help some IBS patients. Regular physical activity can also help keep the gastrointestinal tract functioning properly. Drugs such as propantheline that slow the function of the gastrointestinal tract are generally not effective for treating IBS. Antidiarrheal drugs, such as diphenoxylate and loperamide, help with diarrhea. *The Merck Manual of Medical Information* 525-526 (R. Berkow ed., 1997).

Certain pharmaceutical agents have been administered for treating addiction. U.S. Patent No. 5,556,838 to Mayer *et al.* discloses the use of nontoxic NMDA-blocking agents co-administered with an addictive substance to prevent the development of tolerance or withdrawal symptoms. U.S. Patent No. 5,574,052 to Rose *et al.* discloses co-administration of an addictive substance with an antagonist to partially block the pharmacological effects of the addictive substance. U.S. Patent No. 5,075,341 to Mendelson *et al.* discloses the use of a mixed opiate agonist/antagonist to treat cocaine and opiate addiction. U.S. Patent No. 5,232,934 to Downs discloses administration of 3-phenoxypyridine to treat addiction. U.S. Patents No. 5,039,680 and 5,198,459 to Imperato *et al.* disclose using a serotonin antagonist to treat chemical addiction. U.S. Patent No. 5,556,837 to Nestler et. al. discloses infusing BDNF or NT-4 growth factors to inhibit or reverse neurological adaptive changes that correlate with behavioral changes in an addicted individual. U.S. Patent. No. 5,762,925 to Sagan discloses implanting encapsulated adrenal medullary cells into an animal's central nervous system to inhibit the development of opioid intolerance. U.S. Patent No. 6,204,284 to Beer *et al.* discloses racemic (±)-1-(3,4-dichlorophenyl)-3-azabicyclo[3.1.0]hexane for use in the prevention or relief of a withdrawal syndrome resulting from addiction to drugs and for the treatment of chemical dependencies.

Without treatment, Parkinson's disease progresses to a rigid akinetic state in which patients are incapable of caring for themselves. Death frequently results from complications of immobility, including aspiration pneumonia or pulmonary embolism. Drugs commonly used for the treatment of Parkinson's disease include carbidopa/levodopa, pergolide, bromocriptine, selegiline, amantadine, and trihexyphenidyl hydrochloride. There remains, however, a need for drugs useful for the treatment of Parkinson's disease and having an improved therapeutic profile.

Currently, benzodiazepines are the most commonly used anti-anxiety agents for generalized anxiety disorder. Benzodiazepines, however, carry the risk of producing impairment of cognition and skilled motor functions, particularly in the elderly, which can result in confusion, delerium, and falls with fractures. Sedatives are also commonly prescribed for treating anxiety. The azapirones, such as buspirone, are also used to treat moderate anxiety. The azapirones, however, are less useful for treating severe anxiety accompanied with panic attacks.

Examples of drugs for treating a seizure and epilepsy include carbamazepine, ethosuximide, gabapentin, lamotrigine, phenobarbital, phenytoin, primidone, valproic acid, trimethadione, benzodiazepines, γ-vinyl GABA, acetazolamide, and felbamate. Anti-seizure drugs, however, can have side effects such as drowsiness; hyperactivity; hallucinations; inability to concentrate; central and peripheral nervous system toxicity, such as nystagmus, ataxia, diplopia, and vertigo; gingival hyperplasia; gastrointestinal disturbances such as nausea, vomiting, epigastric pain, and anorexia; endocrine effects such as inhibition of antidiuretic hormone, hyperglycemia, glycosuria, osteomalacia; and hypersensitivity such as scarlatiniform rash, morbilliform rash, Stevens-Johnson syndrome, systemic lupus erythematosus, and hepatic necrosis; and hematological reactions such as red-cell aplasia, agranulocytosis, thrombocytopenia, aplastic anemia, and megaloblastic anemia. *The Merck Manual of Medical Information* 345-350 (R. Berkow ed., 1997).

Symptoms of strokes vary depending on what part of the brain is affected. Symptoms include loss or abnormal sensations in an arm or leg or one side of the body, weakness or paralysis of an arm or leg or one side of the body, partial loss of vison or hearing, double vision, dizziness, slurred speech, difficulty in thinking of the appropriate word or saying it, inability to recognize parts of the body, unusual movements, loss of bladder control, imbalance, and falling, and fainting. The symptoms can be permanent

and can be associated with coma or stupor. Examples of drugs for treating strokes include anticoagulants such as heparin, drugs that break up clots such as streptokinase or tissue plasminogen activator, and drugs that reduce swelling such as mannitol or corticosteroids. *The Merck Manual of Medical Information* 352-355 (R. Berkow ed., 1997).

Pruritus is an unpleasant sensation that prompts scratching. Conventionally, pruritus is treated by phototherapy with ultraviolet B or PUVA or with therapeutic agents such as naltrexone, nalmefene, danazol, tricyclics, and antidepressants.

Selective antagonists of the metabotropic glutamate receptor 5 ("mGluR5") have been shown to exert analgesic activity in *in vivo* animal models (K. Walker *et al.*, *Neuropharmacology* 40:1-9 (2000) and A. Dogrul *et al.*, *Neuroscience Letters*, 292(2):115-118 (2000)).

Selective antagonists of the mGluR5 receptor have also been shown to exert anxiolytic and anti-depressant activity in *in vivo* animal models (E. Tatarczynska *et al.*, *Br. J. Pharmacol.* 132(7):1423-1430 (2001) and P.J.M. Will *et al.*, *Trends in Pharmacological Sciences* 22(7):331-37 (2001)).

Selective antagonists of the mGluR5 receptor have also been shown to exert anti-Parkinson activity *in vivo* (K. J. Ossowska *et al.*, *Neuropharmacology* 41(4):413-20 (2001) and P.J.M. Will *et al.*, *Trends in Pharmacological Sciences* 22(7):331-37 (2001)).

Selective antagonists of the mGluR5 receptor have also been shown to exert anti-dependence activity *in vivo* (C. Chiamulera *et al.*, *Nature Neuroscience* 4(9):873-74 (2001)).

European patent publication no. EP 1 122 242 discloses cyanophenyl and nitrophenyl compounds allegedly having antiandrogen activity.

Japanese patent application no. 2001-328938 discloses cyanophenyl derivatives that allegedly have anti-androgen activity and are useful for the treatment of prostrate cancer and prostrate hypertrophy.

Japanese patent application no. 2001-261657 discloses cyanophenyl derivatives that allegedly have anti-androgen activity.

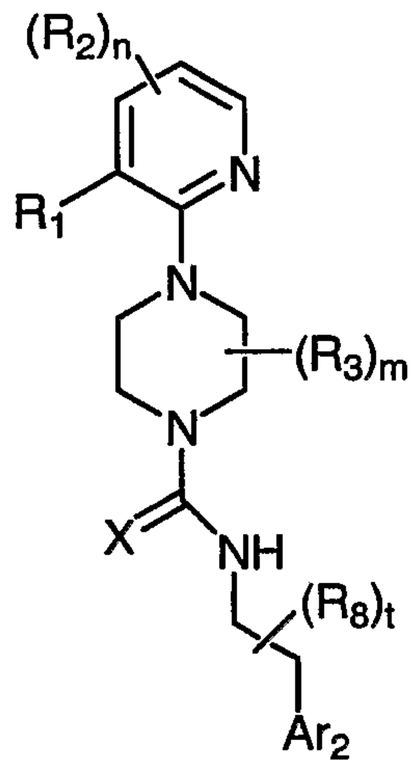
There remains, however, a clear need in the art for new drugs useful for treating or preventing pain, UI, an ulcer, IBD, IBS, an addictive disorder, Parkinson's disease,

parkinsonism, anxiety, epilepsy, stroke, a seizure, a pruritic condition, psychosis, a cognitive disorder, a memory deficit, restricted brain function, Huntington's chorea, ALS, dementia, retinopathy, a muscle spasm, a migraine, vomiting, dyskinesia, or depression.

Citation of any reference in Section 2 of this application is not to be construed as an admission that such reference is prior art to the present application.

3. SUMMARY OF THE INVENTION

The present invention encompasses compounds having the formula (I):

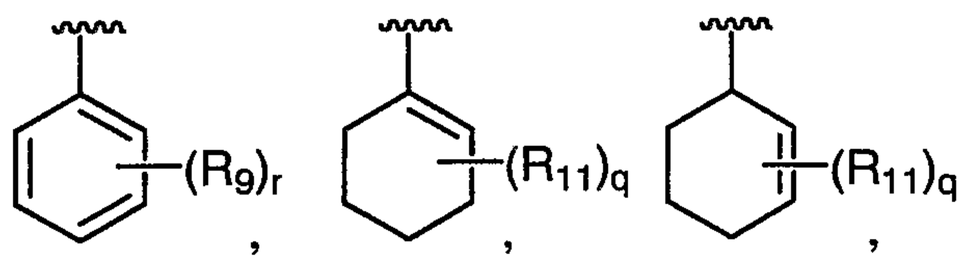


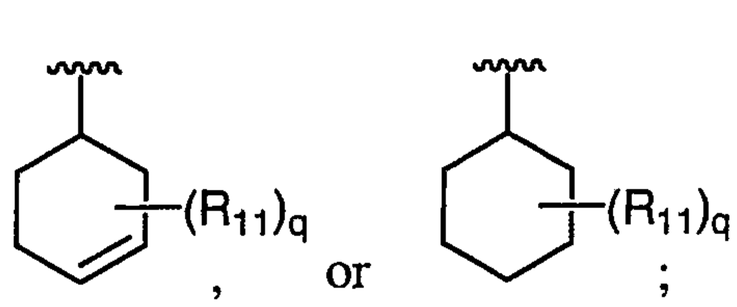
(I)

and pharmaceutically acceptable salts thereof, where:

X is S or O;

Ar_2 is





R_1 is $-CF_3$, $-NO_2$, or -CN;

each R_2 is independently:

(a) -halo,-CN, -OH, -NO_2, or -NH_2;

(b) -(C_1-C_{10})alkyl, -(C_2-C_{10})alkenyl, -(C_2-C_{10})alkynyl, -(C_3-C_{10})cycloalkyl, -(C_8-C_{14})bicycloalkyl, -(C_8-C_{14})tricycloalkyl, -(C_5-C_{10})cycloalkenyl, -(C_8-C_{14})bicycloalkenyl, -(C_8-C_{14})tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups; or

(c) -phenyl, -naphthyl, -(C_{14})aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups;

each R_3 is independently:

(a) -halo, -CN, -OH, -NO_2, or -NH_2;

(b) -(C_1-C_{10})alkyl, -(C_2-C_{10})alkenyl, -(C_2-C_{10})alkynyl, -(C_3-C_{10})cycloalkyl, -(C_8-C_{14})bicycloalkyl, -(C_8-C_{14})tricycloalkyl, -(C_5-C_{10})cycloalkenyl, -(C_8-C_{14})bicycloalkenyl, -(C_8-C_{14})tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups; or

(c) -phenyl, -naphthyl, -(C_{14})aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups;

each R_5 is independently -CN, -OH, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -halo, -N_3, -NO_2, -$N(R_7)_2$, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_6 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, -CH_2(halo), -CN, -OH, -halo, -N_3, -NO_2, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_7 is independently -H, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, or -CH_2(halo);

each R_8 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, or -CH_2(halo);

each R_9 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -C(halo)$_3$, -CH(halo)$_2$, or CH_2(halo), -CN,

-OH, -halo, -N_3, -NO_2, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_{11} is independently -CN, -OH, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -halo, -N_3, -NO_2, -$N(R_7)_2$, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each halo is independently -F, -Cl, -Br, or -I;

n is an integer ranging from 0 to 3;

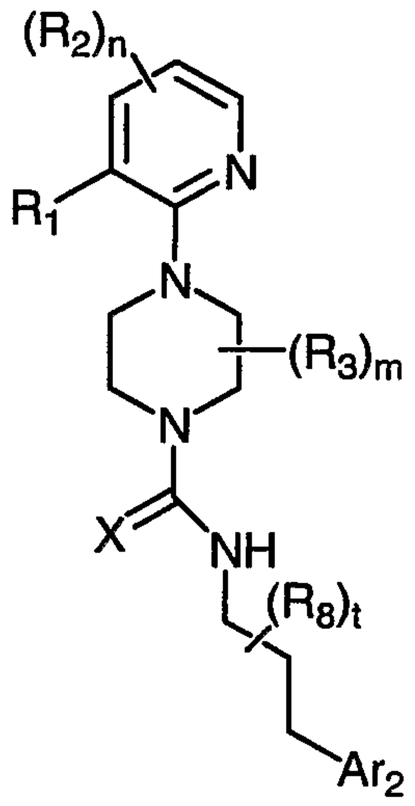
m is 0 or 1;

q is an integer ranging from 0 to 6;

r is an integer ranging from 0 to 5, and

t is an integer ranging from 0 to 2.

The present invention also encompasses compounds having the formula (II):

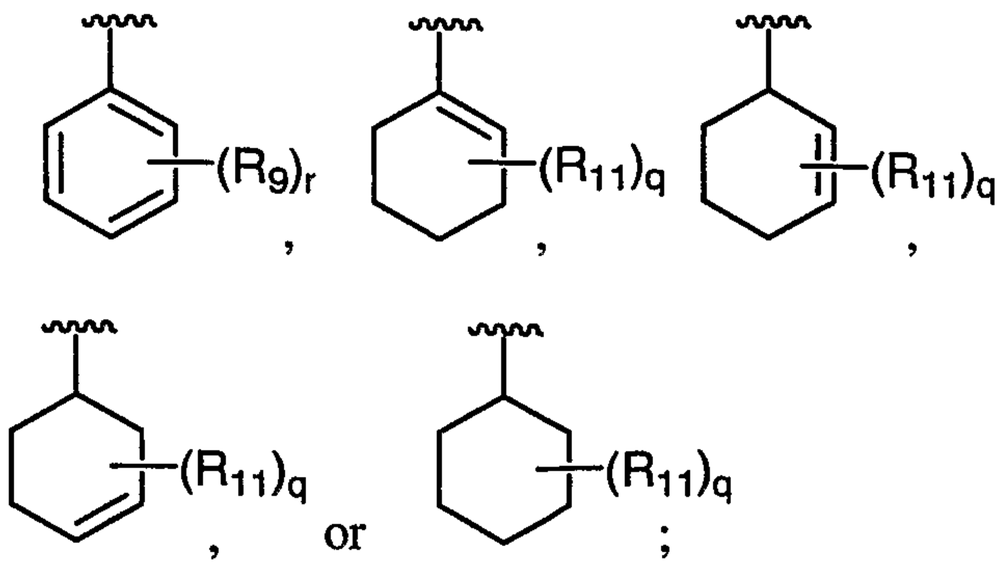


(II)

and pharmaceutically acceptable salts thereof, where:

X is O or S;

Ar_2 is



R_1 is $-CF_3$, $-NO_2$, or -CN;

each R_2 is independently:

(a) -halo,-CN, -OH, $-NO_2$, or $-NH_2$;

(b) $-(C_1\text{-}C_{10})$alkyl, $-(C_2\text{-}C_{10})$alkenyl, $-(C_2\text{-}C_{10})$alkynyl, $-(C_3\text{-}C_{10})$cycloalkyl, $-(C_8\text{-}C_{14})$bicycloalkyl, $-(C_8\text{-}C_{14})$tricycloalkyl, $-(C_5\text{-}C_{10})$cycloalkenyl, $-(C_8\text{-}C_{14})$bicycloalkenyl, $-(C_8\text{-}C_{14})$tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups; or

(c) -phenyl, -naphthyl, $-(C_{14})$aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups;

each R_3 is independently:

(a) -halo, -CN, -OH, $-NO_2$, or $-NH_2$;

(b) $-(C_1\text{-}C_{10})$alkyl, $-(C_2\text{-}C_{10})$alkenyl, $-(C_2\text{-}C_{10})$alkynyl, $-(C_3\text{-}C_{10})$cycloalkyl, $-(C_8\text{-}C_{14})$bicycloalkyl, $-(C_8\text{-}C_{14})$tricycloalkyl, $-(C_5\text{-}C_{10})$cycloalkenyl, $-(C_8\text{-}C_{14})$bicycloalkenyl, $-(C_8\text{-}C_{14})$tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups; or

(c) -phenyl, -naphthyl, $-(C_{14})$aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups;

each R_5 is independently -CN, -OH, $-(C_1\text{-}C_6)$alkyl, $-(C_2\text{-}C_6)$alkenyl, $-(C_2\text{-}C_6)$alkynyl, -halo, $-N_3$, $-NO_2$, $-N(R_7)_2$, $-CH{=}NR_7$, $-NR_7OH$, $-OR_7$, $-COR_7$, $-C(O)OR_7$, $-OC(O)R_7$, $-OC(O)OR_7$, $-SR_7$, $-S(O)R_7$, or $-S(O)_2R_7$;

each R_6 is independently $-(C_1\text{-}C_6)$alkyl, $-(C_2\text{-}C_6)$alkenyl, $-(C_2\text{-}C_6)$alkynyl, $-(C_3\text{-}C_8)$cycloalkyl, $-(C_5\text{-}C_8)$cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, $-C(halo)_3$, $-CH(halo)_2$, $-CH_2(halo)$, -CN, -OH, -halo, $-N_3$, $-NO_2$, $-CH{=}NR_7$, $-NR_7OH$, $-OR_7$, $-COR_7$, $-C(O)OR_7$, $-OC(O)R_7$, $-OC(O)OR_7$, $-SR_7$, $-S(O)R_7$, or $-S(O)_2R_7$;

each R_7 is independently -H, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, or -CH_2(halo);

each R_8 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, or -CH_2(halo);

each R_9 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -C(halo)$_3$, -CH(halo)$_2$, or CH_2(halo), -CN, -OH, -halo, -N_3, -NO_2, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_{11} is independently -CN, -OH, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -halo, -N_3, -NO_2, -$N(R_7)_2$, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each halo is independently -F, -Cl, -Br, or -I;

n is an integer ranging from 0 to 3;

m is 0 or 1;

q is an integer ranging from 0 to 6;

r is an integer ranging from 0 to 5; and

t is an integer ranging from 0 to 2.

A compound of formula (I) and (II) or a pharmaceutically acceptable salt thereof (a "3-substituted Pyridyl Compound") is useful for treating or preventing pain, UI, an ulcer, IBD, IBS, an addictive disorder, Parkinson's disease, parkinsonism, anxiety, epilepsy, stroke, a seizure, a pruritic condition, psychosis, a cognitive disorder, a memory deficit, restricted brain function, Huntington's chorea, ALS, dementia, retinopathy, a muscle spasm, a migraine, vomiting, dyskinesia, or depression (each being a "Condition") in an animal.

The invention also relates to compositions comprising an effective amount of a 3-substituted Pyridyl Compound and a pharmaceutically acceptable carrier or excipient. The compositions are useful for treating or preventing a Condition in an animal.

The invention further relates to methods for treating a Condition, comprising administering to an animal in need thereof an effective amount of a 3-substituted Pyridyl Compound.

The invention further relates to methods for preventing a Condition, comprising administering to an animal in need thereof an effective amount of a 3-substituted Pyridyl Compound.

The invention still further relates to methods for inhibiting Vanilloid Receptor 1 ("VR1") function in a cell, comprising contacting a cell capable of expressing VR1 with an effective amount of a 3-substituted Pyridyl Compound.

The invention still further relates to methods for inhibiting mGluR5 function in a cell, comprising contacting a cell capable of expressing mGluR5 with an effective amount of a 3-substituted Pyridyl Compound.

The invention still further relates to methods for inhibiting metabotropic glutamate receptor 1 ("mGluR1") function in a cell, comprising contacting a cell capable of expressing mGluR1 with an effective amount of a 3-substituted Pyridyl Compound.

The invention still further relates to methods for preparing a composition, comprising the step of admixing a 3-substituted Pyridyl Compound and a pharmaceutically acceptable carrier or excipient.

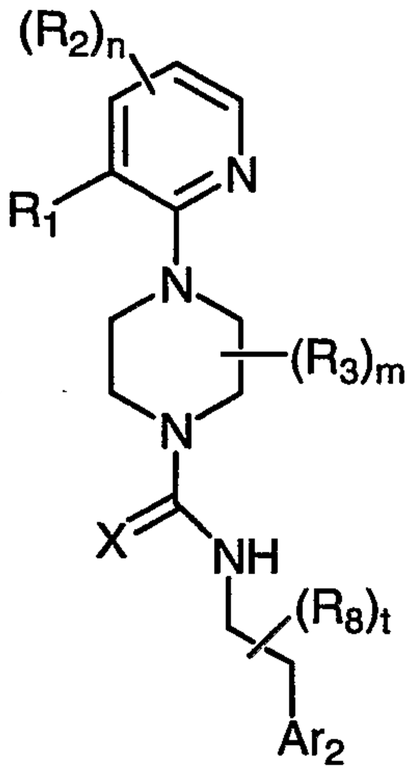
The invention still further relates to a kit comprising a container containing an effective amount of a 3-substituted Pyridyl Compound.

The present invention can be understood more fully by reference to the following detailed description and illustrative examples, which are intended to exemplify non-limiting embodiments of the invention.

4. DETAILED DESCRIPTION OF THE INVENTION

4.1 3-SUBSTITUTED PYRIDYL COMPOUNDS OF FORMULA (I)

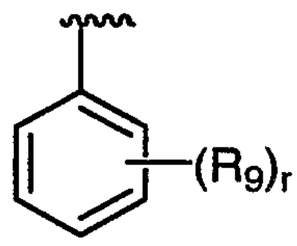
As stated above, the present invention encompasses compounds of Formula (I):



(I)

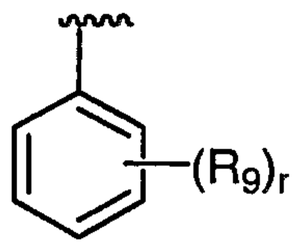
and pharmaceutically acceptable salts thereof, where Ar_2, R_1, R_2, R_3, R_8, n, m, and t are defined above for the 3-substituted Pyridyl Compounds of formula (I).

In one embodiment, Ar_2 is



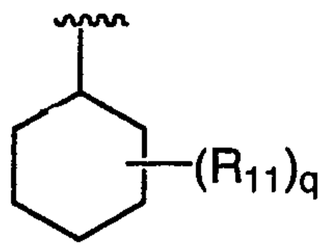
where R_9 and r are defined above for the 3-substituted Pyridyl Compounds of formula (I).

In one embodiment, Ar_2 is



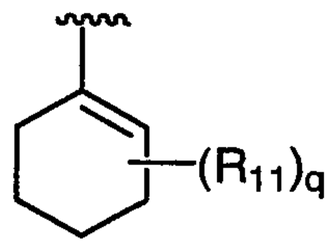
where r is 1 and R_9 is in the 4-position of the phenyl ring.

In another embodiment, Ar_2 is



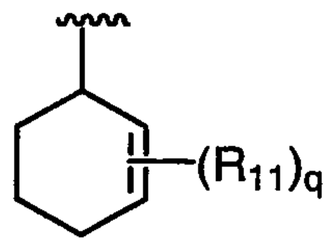
where R_{11} and q are defined above for the 3-substituted Pyridyl Compounds of formula (I).

In another embodiment, Ar_2 is



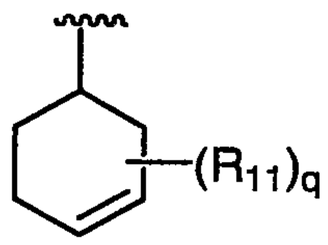
where R_{11} and q are defined above for the 3-substituted Pyridyl Compounds of formula (I).

In another embodiment, Ar_2 is



where R_{11} and q are defined above for the 3-substituted Pyridyl Compounds of formula (I).

In another embodiment, Ar_2 is



where R_{11} and q are defined above for the 3-substituted Pyridyl Compounds of formula (I).

In another embodiment, R_1 is $-CF_3$.

In another embodiment, R_1 is $-NO_2$.

In another embodiment, R_1 is -CN.

In another embodiment, n is 0.

In another embodiment, n is 1 and R_2 is -halo,-OH, or $-NH_2$.

In another embodiment, n is 1 and R_2 is $-(C_1\text{-}C_{10})$alkyl, $-(C_2\text{-}C_{10})$alkenyl, $-(C_2\text{-}C_{10})$alkynyl, $-(C_3\text{-}C_{10})$cycloalkyl, $-(C_8\text{-}C_{14})$bicycloalkyl, $-(C_8\text{-}C_{14})$tricycloalkyl, $-(C_5\text{-}C_{10})$cycloalkenyl, $-(C_8\text{-}C_{14})$bicycloalkenyl, $-(C_8\text{-}C_{14})$tricycloalkenyl, -(3- to 7-

membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups.

In another embodiment, n is 1 and R_2 is -phenyl, -naphthyl, -(C_{14})aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups.

In another embodiment, m is 1 and R_3 is -halo, -CN, -OH, -NO_2, or -NH_2.

In another embodiment, m is 1 and R_3 is -(C_1-C_{10})alkyl, -(C_2-C_{10})alkenyl, -(C_2-C_{10})alkynyl, -(C_3-C_{10})cycloalkyl, -(C_8-C_{14})bicycloalkyl, -(C_8-C_{14})tricycloalkyl, -(C_5-C_{10})cycloalkenyl, -(C_8-C_{14})bicycloalkenyl, -(C_8-C_{14})tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups.

In another embodiment, m is 1 and R_3 is -phenyl, -naphthyl, -(C_{14})aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups.

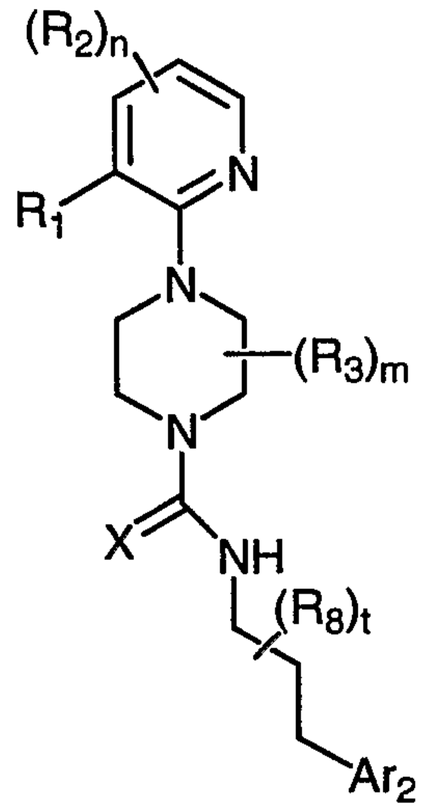
In another embodiment, m is 1 and R_3 is -CH_3.

In another embodiment, m is 1, R_3 is -CH_3, and the carbon atom to which the R_3 is attached is in the (R)-configuration.

In another embodiment, m is 1, R_3 is -CH_3, and the carbon atom to which the R_3 is attached is in the (S)-configuration.

4.2 3-SUBSTITUTED PYRIDYL COMPOUNDS OF FORMULA (II)

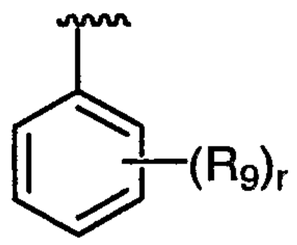
The present invention also encompasses compounds of formula (II):



(II)

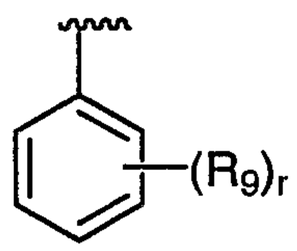
and pharmaceutically acceptable salts thereof, where Ar_2, R_1, R_2, R_3, R_8, n, m, and t are defined above for the 3-substituted Pyridyl Compounds of formula (II).

In another embodiment, Ar_2 is



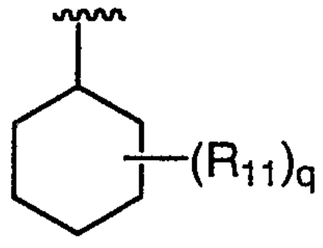
where R_9 and r are defined above for the 3-substituted Pyridyl Compounds of formula (II).

In one embodiment, Ar_2 is



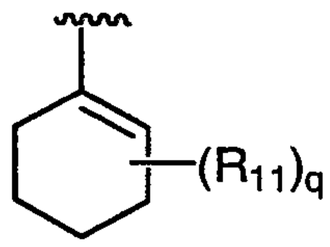
where r is 1 and R_9 is in the 4-position of the phenyl ring.

In another embodiment, Ar_2 is



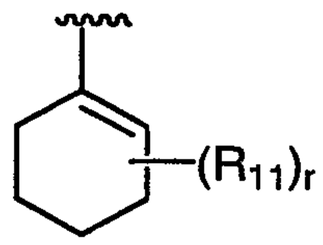
where R_{11} and q are defined above for the 3-substituted Pyridyl Compounds of formula (II).

In another embodiment, Ar_2 is



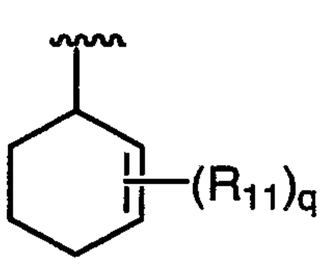
where R_{11} and q are defined above for the 3-substituted Pyridyl Compounds of formula (II).

In another embodiment, Ar_2 is



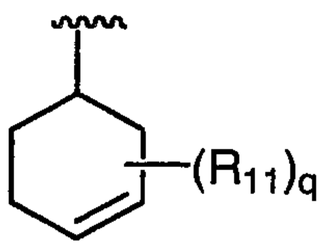
where R_{11} and r are defined above for the 3-substituted Pyridyl Compounds of formula (II).

In another embodiment, Ar_2 is



where R_{11} and q are defined above for the 3-substituted Pyridyl Compounds of formula (II).

In another embodiment, Ar_2 is



where R_{11} and q are defined above for the 3-substituted Pyridyl Compounds of formula (II).

In another embodiment, R_1 is $-CF_3$.

In another embodiment, R_1 is $-NO_2$.

In another embodiment, R_1 is -CN.

In another embodiment, n is 0.

In another embodiment, n is 1 and R_2 is -halo,-OH, or -NH_2.

In another embodiment, n is 1 and R_2 is -(C_1-C_{10})alkyl, -(C_2-C_{10})alkenyl, -(C_2-C_{10})alkynyl, -(C_3-C_{10})cycloalkyl, -(C_8-C_{14})bicycloalkyl, -(C_8-C_{14})tricycloalkyl, -(C_5-C_{10})cycloalkenyl, -(C_8-C_{14})bicycloalkenyl, -(C_8-C_{14})tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups.

In another embodiment, n is 1 and R_2 is -phenyl, -naphthyl, -(C_{14})aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups.

In another embodiment, m is 1 and R_3 is -halo, -CN, -OH, -NO_2, or -NH_2.

In another embodiment, m is 1 and R_3 is -(C_1-C_{10})alkyl, -(C_2-C_{10})alkenyl, -(C_2-C_{10})alkynyl, -(C_3-C_{10})cycloalkyl, -(C_8-C_{14})bicycloalkyl, -(C_8-C_{14})tricycloalkyl, -(C_5-C_{10})cycloalkenyl, -(C_8-C_{14})bicycloalkenyl, -(C_8-C_{14})tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups.

In another embodiment, m is 1 and R_3 is -phenyl, -naphthyl, -(C_{14})aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups.

In another embodiment, m is 1 and R_3 is -CH_3.

In another embodiment, m is 1, R_3 is -CH_3, and the carbon atom to which the R_3 is attached is in the (R)-configuration.

In another embodiment, m is 1, R_3 is -CH_3, and the carbon atom to which the R_3 is attached is in the (S)-configuration.

4.3 3-SUBSTITUTED PYRIDYL COMPOUNDS OF FORMULAS (I) AND (II)

Certain 3-substituted Pyridyl Compounds may have asymmetric centers and therefore exist in different enantiomeric and diastereomeric forms. A 3-substituted Pyridyl Compound can be in the form of an optical isomer or a diastereomer. Accordingly, the invention encompasses 3-substituted Pyridyl Compounds and their uses as described herein in the form of their optical isomers, diasteriomers, and mixtures thereof, including a racemic mixture.

In the 3-substituted Pyridyl Compounds each R_3 can be on any carbon of the piperazine ring. In one embodiment, the 3-substituted Pyridyl Compounds have only one R_3 group, and that R_3 group is attached to a carbon atom adjacent to the nitrogen atom attached to the pyridyl group. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, and that R_3 group is attached to a carbon atom adjacent to the nitrogen atom attached to the phenethyl or phenpropyl group.

In another embodiment, two R_3 groups are on a single atom of the piperazine ring. In another embodiment, an R_3 group is attached to a carbon atom adjacent to the nitrogen atom attached to the pyridyl group and another R_3 group is attached to a carbon atom adjacent to the nitrogen atom attached to the phenethyl or phenpropyl group.

In another embodiment, the 3-substituted Pyridyl Compound has two R_3 groups, each being attached to a different carbon atom adjacent to a nitrogen atom attached to the pyridyl group. In another embodiment, the 3-substituted Pyridyl Compound has two R_3 groups, each being attached to a different carbon atom adjacent to a nitrogen atom attached to the phenethyl or phenpropyl group.

In one embodiment, where the 3-substituted Pyridyl Compound has one or two R_3 groups, the carbon atom to which an R_3 group is attached has the (R) configuration. In another embodiment, where the 3-substituted Pyridyl Compound has one or two R_3 groups, the carbon atom to which the R_3 group is attached has the (S) configuration. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, and at least one of the carbon atoms to which an R_3 group is attached has the (R) configuration. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, and at least one of the carbon atoms to which an R_3 group is attached has the (S) configuration.

In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, and an R_3 group is attached to a carbon atom adjacent to a nitrogen atom attached to the pyridyl group, and the carbon to which the R_3 group is attached is in the (R) configuration. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (R) configuration. and R_3 is -(C_1-C_4)alkyl unsubstituted or substituted with one or more halo groups. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3

groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is $-CH_3$. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is $-CF_3$. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is $-CH_2CH_3$.

In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen atom attached to the phenethyl or phenpropyl group, and the carbon to which the R_3 group is attached is in the (R) configuration. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is $-(C_1\text{-}C_4)$alkyl unsubstituted or substituted with one or more halo groups. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is $-CH_3$. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is $-CF_3$. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is $-CH_2CH_3$.

In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen atom attached to the pyridyl group, and the carbon to which the R_3 group is attached is in the (S) configuration. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (S)

configuration, and R_3 is -(C_1-C_4)alkyl unsubstituted or substituted with one or more halo groups. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -CH_3. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -CF_3. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -CH_2CH_3.

In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen atom attached to the phenethyl or phenpropyl group, and the carbon to which the R_3 group is attached is in the (S) configuration. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -(C_1-C_4)alkyl unsubstituted or substituted with one or more halo groups. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -CH_3. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -CF_3. In another embodiment, the 3-substituted Pyridyl Compound has one or two R_3 groups, an R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -CH_2CH_3.

In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen atom attached to the pyridyl group, and the carbon to which the R_3 group is attached is in the (R) configuration. In another embodiment, the 3-substituted Pyridyl Compound has only one

R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is -(C_1-C_4)alkyl unsubstituted or substituted with one or more halo groups. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is -CH_3. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is -CF_3. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is -CH_2CH_3.

In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen atom attached to the phenethyl or phenpropyl group, and the carbon to which the R_3 group is attached is in the (R) configuration. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the - phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is -(C_1-C_4)alkyl unsubstituted or substituted with one or more halo groups. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is -CH_3. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is -CF_3. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (R) configuration, and R_3 is -CH_2CH_3.

In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen atom attached to

the pyridyl group, and the carbon to which the R_3 group is attached is in the (S) configuration. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -(C_1-C_4)alkyl unsubstituted or substituted with one or more halo groups. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is $-CH_3$. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is $-CF_3$. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the pyridyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is $-CH_2CH_3$.

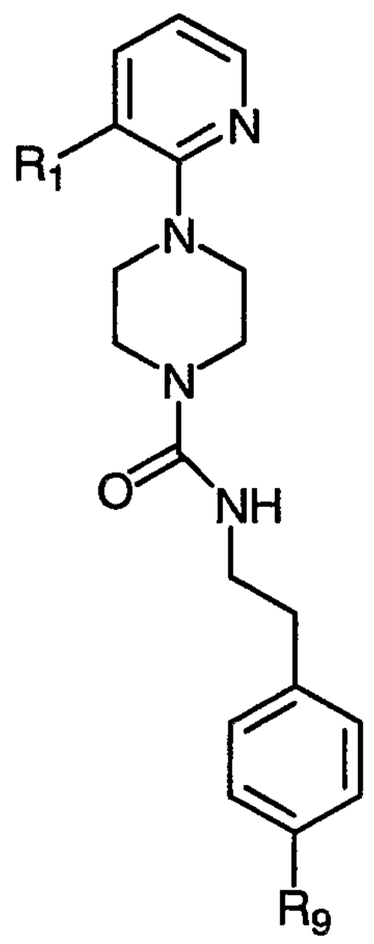
In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen atom attached to the phenethyl or phenpropyl group, and the carbon to which the R_3 group is attached is in the (S) configuration. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is -(C_1-C_4)alkyl unsubstituted or substituted with one or more halo groups. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is $-CH_3$. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_3 group is attached is in the (S) configuration, and R_3 is $-CF_3$. In another embodiment, the 3-substituted Pyridyl Compound has only one R_3 group, the R_3 group is attached to a carbon atom adjacent to a nitrogen attached to the phenethyl or phenpropyl group, the carbon to which the R_5 group is attached is in the (S) configuration, and R_3 is $-CH_2CH_3$.

Optical isomers of the 3-substituted Pyridyl Compounds can be obtained by known techniques such as chiral chromatography or formation of diastereomeric salts from an optically active acid or base.

In addition, one or more hydrogen, carbon or other atoms of a 3-substituted Pyridyl Compound can be replaced by an isotope of the hydrogen, carbon or other atoms. Such compounds, which are encompassed by the present invention, are useful as research and diagnostic tools in metabolism pharmacokinetic studies and in binding assays.

Illustrative 3-substituted Pyridyl Compounds are listed below in Tables 1-12.

Table 1



(III)

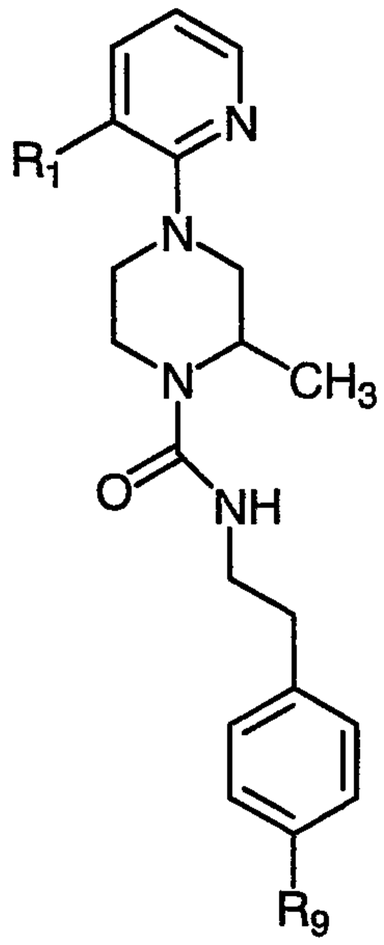
and pharmaceutically acceptable salts thereof, where:

Compound	R_1	R_9
A1	$-CF_3$	-*tert*-butyl
A2	$-CF_3$	-*iso*-butyl
A3	$-CF_3$	-*sec*-butyl
A4	$-CF_3$	-cyclohexyl
A5	$-CF_3$	-*tert*-butoxy

A6	$-CF_3$	-*iso*-propoxy
A7	$-CF_3$	$-CF_3$
A8	$-CF_3$	$-CH_3$
A9	$-CF_3$	$-CH_2CF_3$
A10	$-CF_3$	$-OCF_3$
A11	$-CF_3$	$-OCH_3$
A12	$-CF_3$	-Cl
A13	$-CF_3$	-Br
A14	$-CF_3$	-I
A15	$-CF_3$	-n-butyl
A16	$-CF_3$	-n-propyl
A17	$-CF_3$	-*iso*-propyl
A18	$-CF_3$	$-C_6H_5$
A19	$-CF_3$	-H
A20	$-NO_2$	-*tert*-butyl
A21	$-NO_2$	-*iso*-butyl
A22	$-NO_2$	-*sec*-butyl
A23	$-NO_2$	-cyclohexyl
A24	$-NO_2$	-*tert*-butoxy
A25	$-NO_2$	-*iso*-propoxy
A26	$-NO_2$	$-CF_3$
A27	$-NO_2$	$-CH_3$
A28	$-NO_2$	$-CH_2CF_3$
A29	$-NO_2$	$-OCF_3$
A30	$-NO_2$	$-OCH_3$
A31	$-NO_2$	-Cl
A32	$-NO_2$	-Br
A33	$-NO_2$	-I
A34	$-NO_2$	-n-butyl
A35	$-NO_2$	-n-propyl
A36	$-NO_2$	-*iso*-propyl
A37	$-NO_2$	$-C_6H_5$
A38	$-NO_2$	-H
A39	-CN	-*tert*-butyl
A40	-CN	-*iso*-butyl
A41	-CN	-*sec*-butyl
A42	-CN	-cyclohexyl
A43	-CN	-*tert*-butoxy
A44	-CN	-*iso*-propoxy
A45	-CN	$-CF_3$
A46	-CN	$-CH_3$
A47	-CN	$-CH_2CF_3$
A48	-CN	$-OCF_3$
A49	-CN	$-OCH_3$
A50	-CN	-Cl
A51	-CN	-Br

A52	-CN	-I
A53	-CN	-n-butyl
A54	-CN	-n-propyl
A55	-CN	-*iso*-propyl
A56	-CN	$-C_6H_5$
A57	-CN	-H

Table 2



(IV)

and pharmaceutically acceptable salts thereof, where:

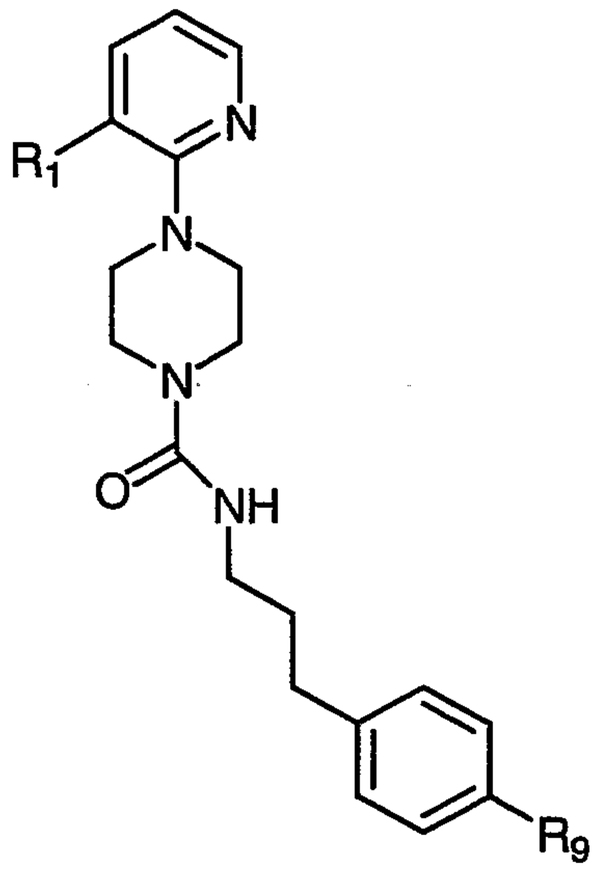
Compound	R_1	R_9
B1 (a) and (b)	$-CF_3$	-*tert*-butyl
B2 (a) and (b)	$-CF_3$	-*iso*-butyl
B3 (a) and (b)	$-CF_3$	-*sec*-butyl
B4 (a) and (b)	$-CF_3$	-cyclohexyl
B5 (a) and (b)	$-CF_3$	-*tert*-butoxy
B6 (a) and (b)	$-CF_3$	-*iso*-propoxy
B7 (a) and (b)	$-CF_3$	$-CF_3$
B8 (a) and (b)	$-CF_3$	$-CH_3$
B9 (a) and (b)	$-CF_3$	$-CH_2CF_3$
B10 (a) and (b)	$-CF_3$	$-OCF_3$
B11 (a) and (b)	$-CF_3$	$-OCH_3$
B12 (a) and (b)	$-CF_3$	-Cl
B13 (a) and (b)	$-CF_3$	-Br
B14 (a) and (b)	$-CF_3$	-I
B15 (a) and (b)	$-CF_3$	-n-butyl
B16 (a) and (b)	$-CF_3$	-n-propyl
B17 (a) and (b)	$-CF_3$	-*iso*-propyl
B18 (a) and (b)	$-CF_3$	$-C_6H_5$
B19 (a) and (b)	$-CF_3$	-H
B20 (a) and (b)	$-NO_2$	-*tert*-butyl
B21 (a) and (b)	$-NO_2$	-*iso*-butyl

B22 (a) and (b)	$-NO_2$	-*sec*-butyl
B23 (a) and (b)	$-NO_2$	-cyclohexyl
B24 (a) and (b)	$-NO_2$	-*tert*-butoxy
B25 (a) and (b)	$-NO_2$	-*iso*-propoxy
B26 (a) and (b)	$-NO_2$	$-CF_3$
B27 (a) and (b)	$-NO_2$	$-CH_3$
B28 (a) and (b)	$-NO_2$	$-CH_2CF_3$
B29 (a) and (b)	$-NO_2$	$-OCF_3$
B30 (a) and (b)	$-NO_2$	$-OCH_3$
B31 (a) and (b)	$-NO_2$	-Cl
B32 (a) and (b)	$-NO_2$	-Br
B33 (a) and (b)	$-NO_2$	-I
B34 (a) and (b)	$-NO_2$	-n-butyl
B35 (a) and (b)	$-NO_2$	-n-propyl
B36 (a) and (b)	$-NO_2$	-*iso*-propyl
B37 (a) and (b)	$-NO_2$	$-C_6H_5$
B38 (a) and (b)	$-NO_2$	-H
B39 (a) and (b)	-CN	-*tert*-butyl
B40 (a) and (b)	-CN	-*iso*-butyl
B41 (a) and (b)	-CN	-*sec*-butyl
B42 (a) and (b)	-CN	-cyclohexyl
B43 (a) and (b)	-CN	-*tert*-butoxy
B44 (a) and (b)	-CN	-*iso*-propoxy
B45 (a) and (b)	-CN	$-CF_3$
B46 (a) and (b)	-CN	$-CH_3$
B47 (a) and (b)	-CN	$-CH_2CF_3$
B48 (a) and (b)	-CN	$-OCF_3$
B49 (a) and (b)	-CN	$-OCH_3$
B50 (a) and (b)	-CN	-Cl
B51 (a) and (b)	-CN	-Br
B52 (a) and (b)	-CN	-I
B53 (a) and (b)	-CN	-n-butyl
B54 (a) and (b)	-CN	-n-propyl
B55 (a) and (b)	-CN	-*iso*-propyl
B56 (a) and (b)	-CN	$-C_6H_5$
B57 (a) and (b)	-CN	-H

where "(a)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the R configuration, and "(b)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the S configuration.

5

Table 3



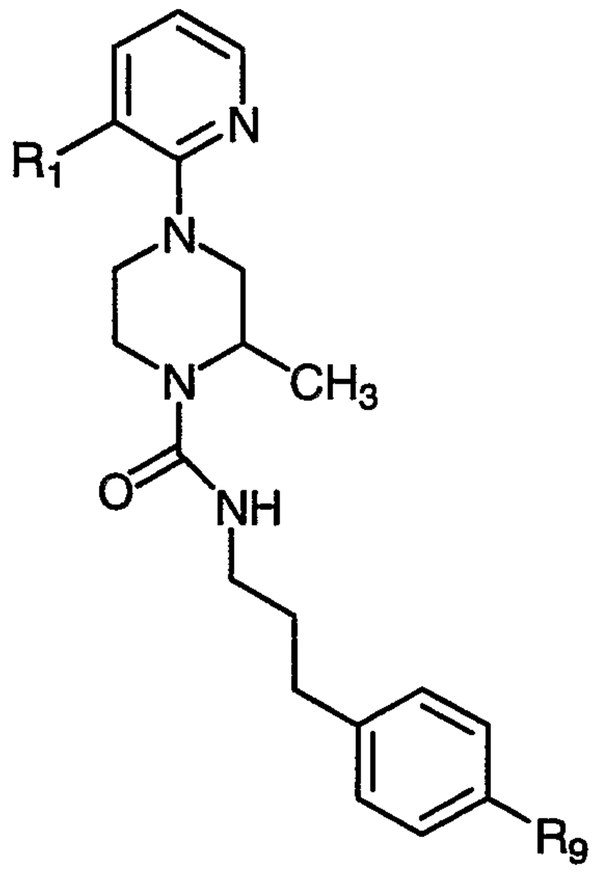
(V)

and pharmaceutically acceptable salts thereof, where:

Compound	R_1	R_9
C1	$-CF_3$	-*tert*-butyl
C2	$-CF_3$	-*iso*-butyl
C3	$-CF_3$	-*sec*-butyl
C4	$-CF_3$	-cyclohexyl
C5	$-CF_3$	-*tert*-butoxy
C6	$-CF_3$	-*iso*-propoxy
C7	$-CF_3$	$-CF_3$
C8	$-CF_3$	$-CH_3$
C9	$-CF_3$	$-CH_2CF_3$
C10	$-CF_3$	$-OCF_3$
C11	$-CF_3$	$-OCH_3$
C12	$-CF_3$	-Cl
C13	$-CF_3$	-Br
C14	$-CF_3$	-I
C15	$-CF_3$	-n-butyl
C16	$-CF_3$	-n-propyl
C17	$-CF_3$	-*iso*-propyl
C18	$-CF_3$	$-C_6H_5$
C19	$-CF_3$	-H
C20	$-NO_2$	-*tert*-butyl
C21	$-NO_2$	-*iso*-butyl

C22	$-NO_2$	-*sec*-butyl
C23	$-NO_2$	-cyclohexyl
C24	$-NO_2$	-*tert*-butoxy
C25	$-NO_2$	-*iso*-propoxy
C26	$-NO_2$	$-CF_3$
C27	$-NO_2$	$-CH_3$
C28	$-NO_2$	$-CH_2CF_3$
C29	$-NO_2$	$-OCF_3$
C30	$-NO_2$	$-OCH_3$
C31	$-NO_2$	-Cl
C32	$-NO_2$	-Br
C33	$-NO_2$	-I
C34	$-NO_2$	-n-butyl
C35	$-NO_2$	-n-propyl
C36	$-NO_2$	-*iso*-propyl
C37	$-NO_2$	$-C_6H_5$
C38	$-NO_2$	-H
C39	-CN	-*tert*-butyl
C40	-CN	-*iso*-butyl
C41	-CN	-*sec*-butyl
C42	-CN	-cyclohexyl
C43	-CN	-*tert*-butoxy
C44	-CN	-*iso*-propoxy
C45	-CN	$-CF_3$
C46	-CN	$-CH_3$
C47	-CN	$-CH_2CF_3$
C48	-CN	$-OCF_3$
C49	-CN	$-OCH_3$
C50	-CN	-Cl
C51	-CN	-Br
C52	-CN	-I
C53	-CN	-n-butyl
C54	-CN	-n-propyl
C55	-CN	-*iso*-propyl
C56	-CN	$-C_6H_5$
C57	-CN	-H

Table 4



(VI)

and pharmaceutically acceptable salts thereof, where:

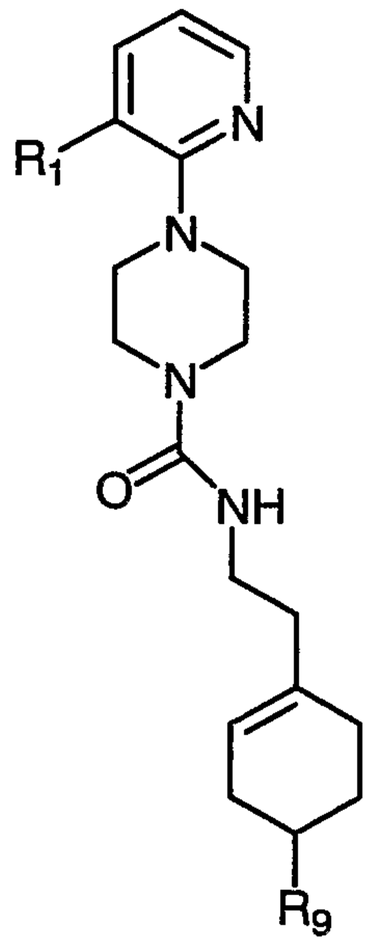
Compound	R_1	R_9
D1 (a) and (b)	$-CF_3$	-*tert*-butyl
D2 (a) and (b)	$-CF_3$	-*iso*-butyl
D3 (a) and (b)	$-CF_3$	-*sec*-butyl
D4 (a) and (b)	$-CF_3$	-cyclohexyl
D5 (a) and (b)	$-CF_3$	-*tert*-butoxy
D6 (a) and (b)	$-CF_3$	-*iso*-propoxy
D7 (a) and (b)	$-CF_3$	$-CF_3$
D8 (a) and (b)	$-CF_3$	$-CH_3$
D9 (a) and (b)	$-CF_3$	$-CH_2CF_3$
D10 (a) and (b)	$-CF_3$	$-OCF_3$
D11 (a) and (b)	$-CF_3$	$-OCH_3$
D12 (a) and (b)	$-CF_3$	-Cl
D13 (a) and (b)	$-CF_3$	-Br
D14 (a) and (b)	$-CF_3$	-I
D15 (a) and (b)	$-CF_3$	-n-butyl
D16 (a) and (b)	$-CF_3$	-n-propyl
D17 (a) and (b)	$-CF_3$	-*iso*-propyl
D18 (a) and (b)	$-CF_3$	$-C_6H_5$
D19 (a) and (b)	$-CF_3$	-H
D20 (a) and (b)	$-NO_2$	-*tert*-butyl
D21 (a) and (b)	$-NO_2$	-*iso*-butyl
D22 (a) and (b)	$-NO_2$	-*sec*-butyl

D23 (a) and (b)	$-NO_2$	-cyclohexyl
D24 (a) and (b)	$-NO_2$	-*tert*-butoxy
D25 (a) and (b)	$-NO_2$	-*iso*-propoxy
D26 (a) and (b)	$-NO_2$	$-CF_3$
D27 (a) and (b)	$-NO_2$	$-CH_3$
D28 (a) and (b)	$-NO_2$	$-CH_2CF_3$
D29 (a) and (b)	$-NO_2$	$-OCF_3$
D30 (a) and (b)	$-NO_2$	$-OCH_3$
D31 (a) and (b)	$-NO_2$	-Cl
D32 (a) and (b)	$-NO_2$	-Br
D33 (a) and (b)	$-NO_2$	-I
D34 (a) and (b)	$-NO_2$	-n-butyl
D35 (a) and (b)	$-NO_2$	-n-propyl
D36 (a) and (b)	$-NO_2$	-*iso*-propyl
D37 (a) and (b)	$-NO_2$	$-C_6H_5$
D38 (a) and (b)	$-NO_2$	-H
D39 (a) and (b)	-CN	-*tert*-butyl
D40 (a) and (b)	-CN	-*iso*-butyl
D41 (a) and (b)	-CN	-*sec*-butyl
D42 (a) and (b)	-CN	-cyclohexyl
D43 (a) and (b)	-CN	-*tert*-butoxy
D44 (a) and (b)	-CN	-*iso*-propoxy
D45 (a) and (b)	-CN	$-CF_3$
D46 (a) and (b)	-CN	$-CH_3$
D47 (a) and (b)	-CN	$-CH_2CF_3$
D48 (a) and (b)	-CN	$-OCF_3$
D49 (a) and (b)	-CN	$-OCH_3$
D50 (a) and (b)	-CN	-Cl
D51 (a) and (b)	-CN	-Br
D52 (a) and (b)	-CN	-I
D53 (a) and (b)	-CN	-n-butyl
D54 (a) and (b)	-CN	-n-propyl
D55 (a) and (b)	-CN	-*iso*-propyl
D56 (a) and (b)	-CN	$-C_6H_5$
D57 (a) and (b)	-CN	-H

where "(a)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the R configuration, and "(b)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the S configuration.

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Table 5



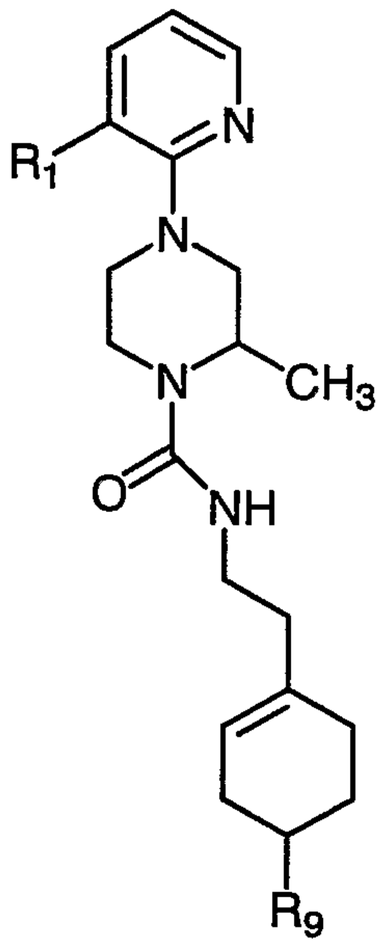
(VII)

and pharmaceutically acceptable salts thereof, where:

Compound	R_1	R_9
E1	$-CF_3$	-*tert*-butyl
E2	$-CF_3$	-*iso*-butyl
E3	$-CF_3$	-*sec*-butyl
E4	$-CF_3$	-cyclohexyl
E5	$-CF_3$	-*tert*-butoxy
E6	$-CF_3$	-*iso*-propoxy
E7	$-CF_3$	$-CF_3$
E8	$-CF_3$	$-CH_3$
E9	$-CF_3$	$-CH_2CF_3$
E10	$-CF_3$	$-OCF_3$
E11	$-CF_3$	$-OCH_3$
E12	$-CF_3$	-Cl
E13	$-CF_3$	-Br
E14	$-CF_3$	-I
E15	$-CF_3$	-n-butyl
E16	$-CF_3$	-n-propyl
E17	$-CF_3$	-*iso*-propyl
E18	$-CF_3$	$-C_6H_5$
E19	$-CF_3$	-H
E20	$-NO_2$	-*tert*-butyl

E21	$-NO_2$	-*iso*-butyl
E22	$-NO_2$	-*sec*-butyl
E23	$-NO_2$	-cyclohexyl
E24	$-NO_2$	-*tert*-butoxy
E25	$-NO_2$	-*iso*-propoxy
E26	$-NO_2$	$-CF_3$
E27	$-NO_2$	$-CH_3$
E28	$-NO_2$	$-CH_2CF_3$
E29	$-NO_2$	$-OCF_3$
E30	$-NO_2$	$-OCH_3$
E31	$-NO_2$	-Cl
E32	$-NO_2$	-Br
E33	$-NO_2$	-I
E34	$-NO_2$	-n-butyl
E35	$-NO_2$	-n-propyl
E36	$-NO_2$	-*iso*-propyl
E37	$-NO_2$	$-C_6H_5$
E38	$-NO_2$	-H
E39	-CN	-*tert*-butyl
E40	-CN	-*iso*-butyl
E41	-CN	-*sec*-butyl
E42	-CN	-cyclohexyl
E43	-CN	-*tert*-butoxy
E44	-CN	-*iso*-propoxy
E45	-CN	$-CF_3$
E46	-CN	$-CH_3$
E47	-CN	$-CH_2CF_3$
E48	-CN	$-OCF_3$
E49	-CN	$-OCH_3$
E50	-CN	-Cl
E51	-CN	-Br
E52	-CN	-I
E53	-CN	-n-butyl
E54	-CN	-n-propyl
E55	-CN	-*iso*-propyl
E56	-CN	$-C_6H_5$
E57	-CN	-H

Table 6



(VIII)

and pharmaceutically acceptable salts thereof, where:

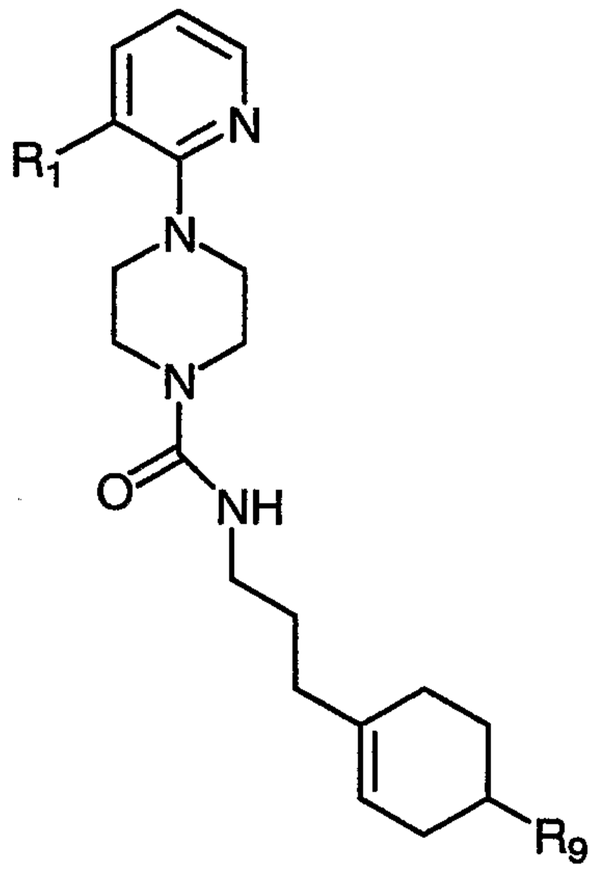
Compound	R_1	R_9
F1 (a) and (b)	$-CF_3$	-*tert*-butyl
F2 (a) and (b)	$-CF_3$	-*iso*-butyl
F3 (a) and (b)	$-CF_3$	-*sec*-butyl
F4 (a) and (b)	$-CF_3$	-cyclohexyl
F5 (a) and (b)	$-CF_3$	-*tert*-butoxy
F6 (a) and (b)	$-CF_3$	-*iso*-propoxy
F7 (a) and (b)	$-CF_3$	$-CF_3$
F8 (a) and (b)	$-CF_3$	$-CH_3$
F9 (a) and (b)	$-CF_3$	$-CH_2CF_3$
F10 (a) and (b)	$-CF_3$	$-OCF_3$
F11 (a) and (b)	$-CF_3$	$-OCH_3$
F12 (a) and (b)	$-CF_3$	-Cl
F13 (a) and (b)	$-CF_3$	-Br
F14 (a) and (b)	$-CF_3$	-I
F15 (a) and (b)	$-CF_3$	-n-butyl
F16 (a) and (b)	$-CF_3$	-n-propyl
F17 (a) and (b)	$-CF_3$	-*iso*-propyl
F18 (a) and (b)	$-CF_3$	$-C_6H_5$
F19 (a) and (b)	$-CF_3$	-H
F20 (a) and (b)	$-NO_2$	-*tert*-butyl
F21 (a) and (b)	$-NO_2$	-*iso*-butyl

F22 (a) and (b)	$-NO_2$	-*sec*-butyl
F23 (a) and (b)	$-NO_2$	-cyclohexyl
F24 (a) and (b)	$-NO_2$	-*tert*-butoxy
F25 (a) and (b)	$-NO_2$	-*iso*-propoxy
F26 (a) and (b)	$-NO_2$	$-CF_3$
F27 (a) and (b)	$-NO_2$	$-CH_3$
F28 (a) and (b)	$-NO_2$	$-CH_2CF_3$
F29 (a) and (b)	$-NO_2$	$-OCF_3$
F30 (a) and (b)	$-NO_2$	$-OCH_3$
F31 (a) and (b)	$-NO_2$	-Cl
F32 (a) and (b)	$-NO_2$	-Br
F33 (a) and (b)	$-NO_2$	-I
F34 (a) and (b)	$-NO_2$	-n-butyl
F35 (a) and (b)	$-NO_2$	-n-propyl
F36 (a) and (b)	$-NO_2$	-*iso*-propyl
F37 (a) and (b)	$-NO_2$	$-C_6H_5$
F38 (a) and (b)	$-NO_2$	-H
F39 (a) and (b)	-CN	-*tert*-butyl
F40 (a) and (b)	-CN	-*iso*-butyl
F41 (a) and (b)	-CN	-*sec*-butyl
F42 (a) and (b)	-CN	-cyclohexyl
F43 (a) and (b)	-CN	-*tert*-butoxy
F44 (a) and (b)	-CN	-*iso*-propoxy
F45 (a) and (b)	-CN	$-CF_3$
F46 (a) and (b)	-CN	$-CH_3$
F47 (a) and (b)	-CN	$-CH_2CF_3$
F48 (a) and (b)	-CN	$-OCF_3$
F49 (a) and (b)	-CN	$-OCH_3$
F50 (a) and (b)	-CN	-Cl
F51 (a) and (b)	-CN	-Br
F52 (a) and (b)	-CN	-I
F53 (a) and (b)	-CN	-n-butyl
F54 (a) and (b)	-CN	-n-propyl
F55 (a) and (b)	-CN	-*iso*-propyl
F56 (a) and (b)	-CN	$-C_6H_5$
F57 (a) and (b)	-CN	-H

where "(a)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the R configuration, and "(b)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the S configuration.

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Table 7



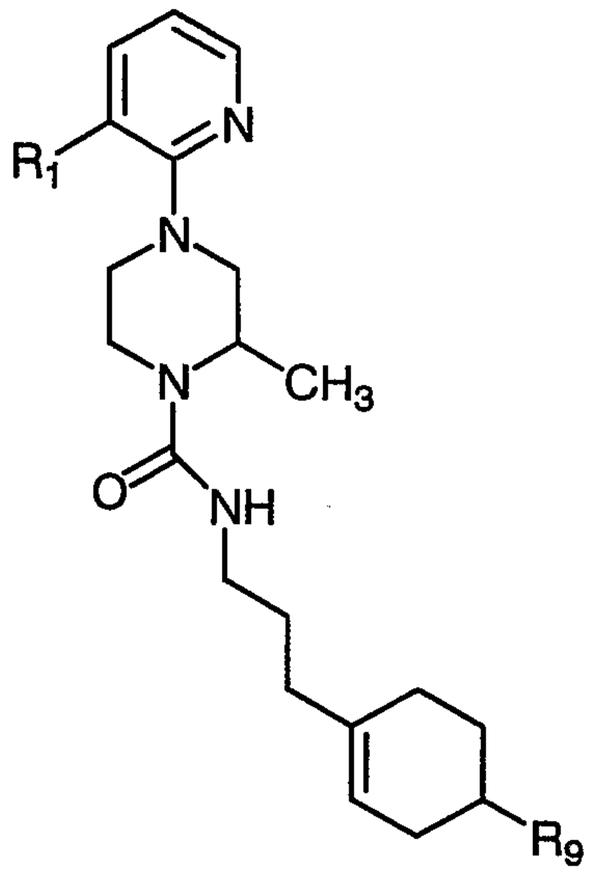
(IX)

and pharmaceutically acceptable salts thereof, where:

Compound	R_1	R_9
G1	$-CF_3$	-*tert*-butyl
G2	$-CF_3$	-*iso*-butyl
G3	$-CF_3$	-*sec*-butyl
G4	$-CF_3$	-cyclohexyl
G5	$-CF_3$	-*tert*-butoxy
G6	$-CF_3$	-*iso*-propoxy
G7	$-CF_3$	$-CF_3$
G8	$-CF_3$	$-CH_3$
G9	$-CF_3$	$-CH_2CF_3$
G10	$-CF_3$	$-OCF_3$
G11	$-CF_3$	$-OCH_3$
G12	$-CF_3$	-Cl
G13	$-CF_3$	-Br
G14	$-CF_3$	-I
G15	$-CF_3$	-n-butyl
G16	$-CF_3$	-n-propyl
G17	$-CF_3$	-*iso*-propyl
G18	$-CF_3$	$-C_6H_5$
G19	$-CF_3$	-H
G20	$-NO_2$	-*tert*-butyl
G21	$-NO_2$	-*iso*-butyl
G22	$-NO_2$	-*sec*-butyl

G23	$-NO_2$	-cyclohexyl
G24	$-NO_2$	-*tert*-butoxy
G25	$-NO_2$	-*iso*-propoxy
G26	$-NO_2$	$-CF_3$
G27	$-NO_2$	$-CH_3$
G28	$-NO_2$	$-CH_2CF_3$
G29	$-NO_2$	$-OCF_3$
G30	$-NO_2$	$-OCH_3$
G31	$-NO_2$	-Cl
G32	$-NO_2$	-Br
G33	$-NO_2$	-I
G34	$-NO_2$	-n-butyl
G35	$-NO_2$	-n-propyl
G36	$-NO_2$	-*iso*-propyl
G37	$-NO_2$	$-C_6H_5$
G38	$-NO_2$	-H
G39	-CN	-*tert*-butyl
G40	-CN	-*iso*-butyl
G41	-CN	-*sec*-butyl
G42	-CN	-cyclohexyl
G43	-CN	-*tert*-butoxy
G44	-CN	-*iso*-propoxy
G45	-CN	$-CF_3$
G46	-CN	$-CH_3$
G47	-CN	$-CH_2CF_3$
G48	-CN	$-OCF_3$
G49	-CN	$-OCH_3$
G50	-CN	-Cl
G51	-CN	-Br
G52	-CN	-I
G53	-CN	-n-butyl
G54	-CN	-n-propyl
G55	-CN	-*iso*-propyl
G56	-CN	$-C_6H_5$
G57	-CN	-H

Table 8



(X)

and pharmaceutically acceptable salts thereof, where:

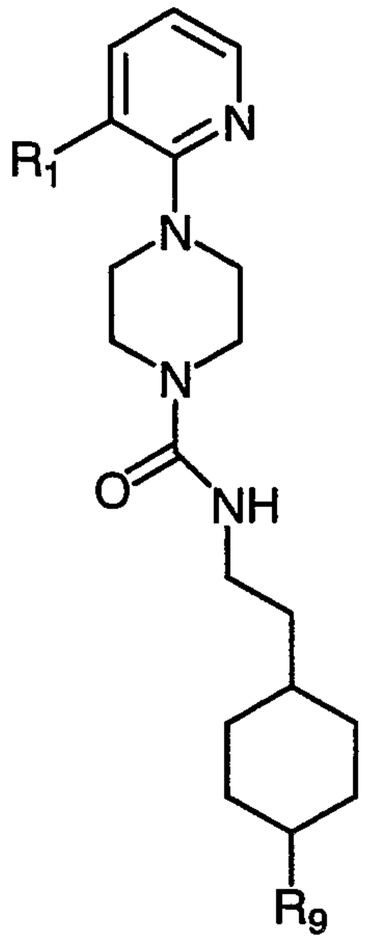
Compound	R_1	R_9
H1 (a) and (b)	$-CF_3$	-*tert*-butyl
H2 (a) and (b)	$-CF_3$	-*iso*-butyl
H3 (a) and (b)	$-CF_3$	-*sec*-butyl
H4 (a) and (b)	$-CF_3$	-cyclohexyl
H5 (a) and (b)	$-CF_3$	-*tert*-butoxy
H6 (a) and (b)	$-CF_3$	-*iso*-propoxy
H7 (a) and (b)	$-CF_3$	$-CF_3$
H8 (a) and (b)	$-CF_3$	$-CH_3$
H9 (a) and (b)	$-CF_3$	$-CH_2CF_3$
H10 (a) and (b)	$-CF_3$	$-OCF_3$
H11 (a) and (b)	$-CF_3$	$-OCH_3$
H12 (a) and (b)	$-CF_3$	-Cl
H13 (a) and (b)	$-CF_3$	-Br
H14 (a) and (b)	$-CF_3$	-I
H15 (a) and (b)	$-CF_3$	-n-butyl
H16 (a) and (b)	$-CF_3$	-n-propyl
H17 (a) and (b)	$-CF_3$	-*iso*-propyl
H18 (a) and (b)	$-CF_3$	$-C_6H_5$
H19 (a) and (b)	$-CF_3$	-H
H20 (a) and (b)	$-NO_2$	-*tert*-butyl
H21 (a) and (b)	$-NO_2$	-*iso*-butyl
H22 (a) and (b)	$-NO_2$	-*sec*-butyl

H23 (a) and (b)	$-NO_2$	-cyclohexyl
H24 (a) and (b)	$-NO_2$	-*tert*-butoxy
H25 (a) and (b)	$-NO_2$	-*iso*-propoxy
H26 (a) and (b)	$-NO_2$	$-CF_3$
H27 (a) and (b)	$-NO_2$	$-CH_3$
H28 (a) and (b)	$-NO_2$	$-CH_2CF_3$
H29 (a) and (b)	$-NO_2$	$-OCF_3$
H30 (a) and (b)	$-NO_2$	$-OCH_3$
H31 (a) and (b)	$-NO_2$	-Cl
H32 (a) and (b)	$-NO_2$	-Br
H33 (a) and (b)	$-NO_2$	-I
H34 (a) and (b)	$-NO_2$	-n-butyl
H35 (a) and (b)	$-NO_2$	-n-propyl
H36 (a) and (b)	$-NO_2$	-*iso*-propyl
H37 (a) and (b)	$-NO_2$	$-C_6H_5$
H38 (a) and (b)	$-NO_2$	-H
H39 (a) and (b)	-CN	-*tert*-butyl
H40 (a) and (b)	-CN	-*iso*-butyl
H41 (a) and (b)	-CN	-*sec*-butyl
H42 (a) and (b)	-CN	-cyclohexyl
H43 (a) and (b)	-CN	-*tert*-butoxy
H44 (a) and (b)	-CN	-*iso*-propoxy
H45 (a) and (b)	-CN	$-CF_3$
H46 (a) and (b)	-CN	$-CH_3$
H47 (a) and (b)	-CN	$-CH_2CF_3$
H48 (a) and (b)	-CN	$-OCF_3$
H49 (a) and (b)	-CN	$-OCH_3$
H50 (a) and (b)	-CN	-Cl
H51 (a) and (b)	-CN	-Br
H52 (a) and (b)	-CN	-I
H53 (a) and (b)	-CN	-n-butyl
H54 (a) and (b)	-CN	-n-propyl
H55 (a) and (b)	-CN	-*iso*-propyl
H56 (a) and (b)	-CN	$-C_6H_5$
H57 (a) and (b)	-CN	-H

where "(a)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the R configuration, and "(b)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the S configuration.

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Table 9



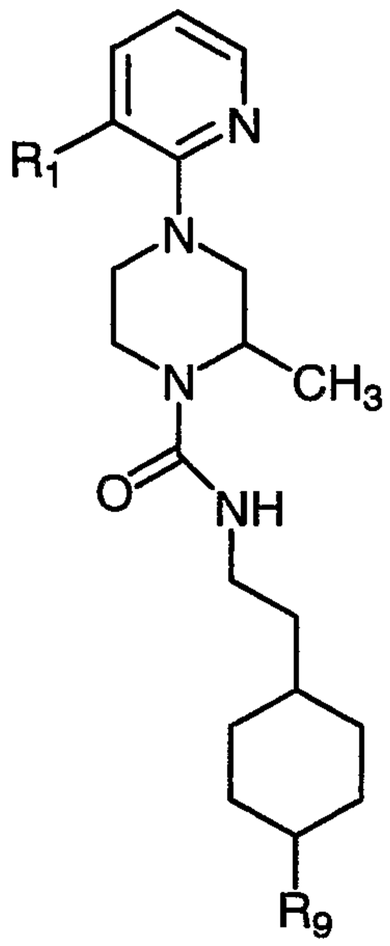
(XI)

and pharmaceutically acceptable salts thereof, where:

Compound	R_1	R_9
I1	$-CF_3$	-*tert*-butyl
I2	$-CF_3$	-*iso*-butyl
I3	$-CF_3$	-*sec*-butyl
I4	$-CF_3$	-cyclohexyl
I5	$-CF_3$	-*tert*-butoxy
I6	$-CF_3$	-*iso*-propoxy
I7	$-CF_3$	$-CF_3$
I8	$-CF_3$	$-CH_3$
I9	$-CF_3$	$-CH_2CF_3$
I10	$-CF_3$	$-OCF_3$
I11	$-CF_3$	$-OCH_3$
I12	$-CF_3$	-Cl
I13	$-CF_3$	-Br
I14	$-CF_3$	-I
I15	$-CF_3$	-n-butyl
I16	$-CF_3$	-n-propyl
I17	$-CF_3$	-*iso*-propyl
I18	$-CF_3$	$-C_6H_5$
I19	$-CF_3$	-H
I20	$-NO_2$	-*tert*-butyl
I21	$-NO_2$	-*iso*-butyl

I22	$-NO_2$	-*sec*-butyl
I23	$-NO_2$	-cyclohexyl
I24	$-NO_2$	-*tert*-butoxy
I25	$-NO_2$	-*iso*-propoxy
I26	$-NO_2$	$-CF_3$
I27	$-NO_2$	$-CH_3$
I28	$-NO_2$	$-CH_2CF_3$
I29	$-NO_2$	$-OCF_3$
I30	$-NO_2$	$-OCH_3$
I31	$-NO_2$	-Cl
I32	$-NO_2$	-Br
I33	$-NO_2$	-I
I34	$-NO_2$	-n-butyl
I35	$-NO_2$	-n-propyl
I36	$-NO_2$	-*iso*-propyl
I37	$-NO_2$	$-C_6H_5$
I38	$-NO_2$	-H
I39	-CN	-*tert*-butyl
I40	-CN	-*iso*-butyl
I41	-CN	-*sec*-butyl
I42	-CN	-cyclohexyl
I43	-CN	-*tert*-butoxy
I44	-CN	-*iso*-propoxy
I45	-CN	$-CF_3$
I46	-CN	$-CH_3$
I47	-CN	$-CH_2CF_3$
I48	-CN	$-OCF_3$
I49	-CN	$-OCH_3$
I50	-CN	-Cl
I51	-CN	-Br
I52	-CN	-I
I53	-CN	-n-butyl
I54	-CN	-n-propyl
I55	-CN	-*iso*-propyl
I56	-CN	$-C_6H_5$
I57	-CN	-H

Table 10



(XII)

and pharmaceutically acceptable salts thereof, where:

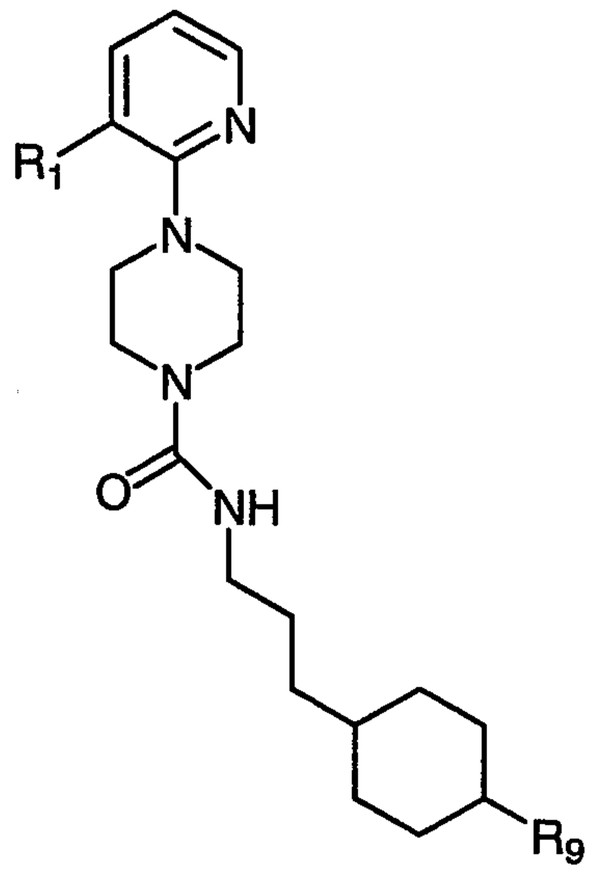
Compound	R_1	R_9
J1 (a) and (b)	$-CF_3$	-*tert*-butyl
J2 (a) and (b)	$-CF_3$	-*iso*-butyl
J3 (a) and (b)	$-CF_3$	-*sec*-butyl
J4 (a) and (b)	$-CF_3$	-cyclohexyl
J5 (a) and (b)	$-CF_3$	-*tert*-butoxy
J6 (a) and (b)	$-CF_3$	-*iso*-propoxy
J7 (a) and (b)	$-CF_3$	$-CF_3$
J8 (a) and (b)	$-CF_3$	$-CH_3$
J9 (a) and (b)	$-CF_3$	$-CH_2CF_3$
J10 (a) and (b)	$-CF_3$	$-OCF_3$
J11 (a) and (b)	$-CF_3$	$-OCH_3$
J12 (a) and (b)	$-CF_3$	-Cl
J13 (a) and (b)	$-CF_3$	-Br
J14 (a) and (b)	$-CF_3$	-I
J15 (a) and (b)	$-CF_3$	-n-butyl
J16 (a) and (b)	$-CF_3$	-n-propyl
J17 (a) and (b)	$-CF_3$	-*iso*-propyl
J18 (a) and (b)	$-CF_3$	$-C_6H_5$
J19 (a) and (b)	$-CF_3$	-H
J20 (a) and (b)	$-NO_2$	-*tert*-butyl
J21 (a) and (b)	$-NO_2$	-*iso*-butyl

J22 (a) and (b)	$-NO_2$	-*sec*-butyl
J23 (a) and (b)	$-NO_2$	-cyclohexyl
J24 (a) and (b)	$-NO_2$	-*tert*-butoxy
J25 (a) and (b)	$-NO_2$	-*iso*-propoxy
J26 (a) and (b)	$-NO_2$	$-CF_3$
J27 (a) and (b)	$-NO_2$	$-CH_3$
J28 (a) and (b)	$-NO_2$	$-CH_2CF_3$
J29 (a) and (b)	$-NO_2$	$-OCF_3$
J30 (a) and (b)	$-NO_2$	$-OCH_3$
J31 (a) and (b)	$-NO_2$	-Cl
J32 (a) and (b)	$-NO_2$	-Br
J33 (a) and (b)	$-NO_2$	-I
J34 (a) and (b)	$-NO_2$	-n-butyl
J35 (a) and (b)	$-NO_2$	-n-propyl
J36 (a) and (b)	$-NO_2$	-*iso*-propyl
J37 (a) and (b)	$-NO_2$	$-C_6H_5$
J38 (a) and (b)	$-NO_2$	-H
J39 (a) and (b)	-CN	-*tert*-butyl
J40 (a) and (b)	-CN	-*iso*-butyl
J41 (a) and (b)	-CN	-*sec*-butyl
J42 (a) and (b)	-CN	-cyclohexyl
J43 (a) and (b)	-CN	-*tert*-butoxy
J44 (a) and (b)	-CN	-*iso*-propoxy
J45 (a) and (b)	-CN	$-CF_3$
J46 (a) and (b)	-CN	$-CH_3$
J47 (a) and (b)	-CN	$-CH_2CF_3$
J48 (a) and (b)	-CN	$-OCF_3$
J49 (a) and (b)	-CN	$-OCH_3$
J50 (a) and (b)	-CN	-Cl
J51 (a) and (b)	-CN	-Br
J52 (a) and (b)	-CN	-I
J53 (a) and (b)	-CN	-n-butyl
J54 (a) and (b)	-CN	-n-propyl
J55 (a) and (b)	-CN	-*iso*-propyl
J56 (a) and (b)	-CN	$-C_6H_5$
J57 (a) and (b)	-CN	-H

where "(a)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the R configuration, and "(b)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the S configuration.

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Table 11



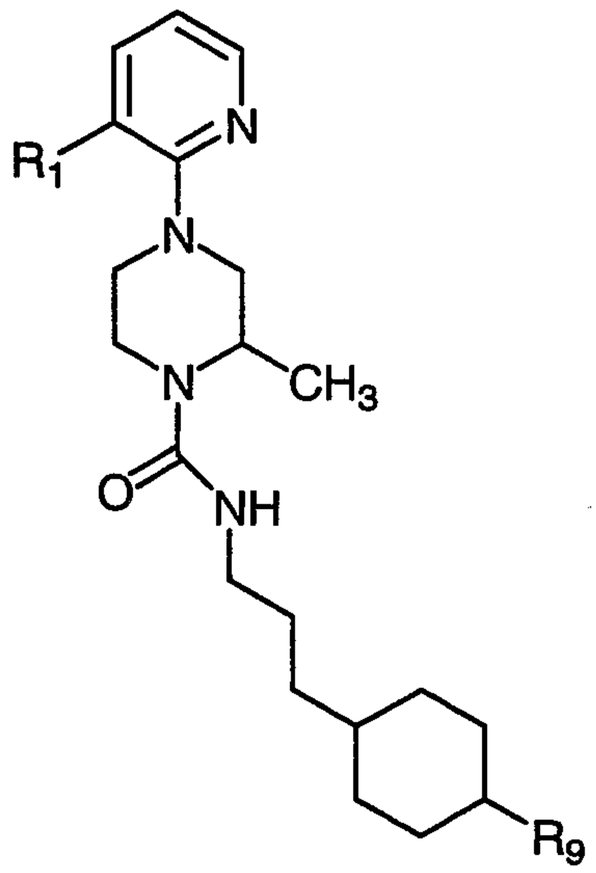
(XIII)

and pharmaceutically acceptable salts thereof, where:

Compound	R_1	R_9
K1	$-CF_3$	-*tert*-butyl
K2	$-CF_3$	-*iso*-butyl
K3	$-CF_3$	-*sec*-butyl
K4	$-CF_3$	-cyclohexyl
K5	$-CF_3$	-*tert*-butoxy
K6	$-CF_3$	-*iso*-propoxy
K7	$-CF_3$	$-CF_3$
K8	$-CF_3$	$-CH_3$
K9	$-CF_3$	$-CH_2CF_3$
K10	$-CF_3$	$-OCF_3$
K11	$-CF_3$	$-OCH_3$
K12	$-CF_3$	-Cl
K13	$-CF_3$	-Br
K14	$-CF_3$	-I
K15	$-CF_3$	-n-butyl
K16	$-CF_3$	-n-propyl
K17	$-CF_3$	-*iso*-propyl
K18	$-CF_3$	$-C_6H_5$
K19	$-CF_3$	-H
K20	$-NO_2$	-*tert*-butyl
K21	$-NO_2$	-*iso*-butyl
K22	$-NO_2$	-*sec*-butyl

K23	$-NO_2$	-cyclohexyl
K24	$-NO_2$	-*tert*-butoxy
K25	$-NO_2$	-*iso*-propoxy
K26	$-NO_2$	$-CF_3$
K27	$-NO_2$	$-CH_3$
K28	$-NO_2$	$-CH_2CF_3$
K29	$-NO_2$	$-OCF_3$
K30	$-NO_2$	$-OCH_3$
K31	$-NO_2$	-Cl
K32	$-NO_2$	-Br
K33	$-NO_2$	-I
K34	$-NO_2$	-n-butyl
K35	$-NO_2$	-n-propyl
K36	$-NO_2$	-*iso*-propyl
K37	$-NO_2$	$-C_6H_5$
K38	$-NO_2$	-H
K39	-CN	-*tert*-butyl
K40	-CN	-*iso*-butyl
K41	-CN	-*sec*-butyl
K42	-CN	-cyclohexyl
K43	-CN	-*tert*-butoxy
K44	-CN	-*iso*-propoxy
K45	-CN	$-CF_3$
K46	-CN	$-CH_3$
K47	-CN	$-CH_2CF_3$
K48	-CN	$-OCF_3$
K49	-CN	$-OCH_3$
K50	-CN	-Cl
K51	-CN	-Br
K52	-CN	-I
K53	-CN	-n-butyl
K54	-CN	-n-propyl
K55	-CN	-*iso*-propyl
K56	-CN	$-C_6H_5$
K57	-CN	-H

Table 12



(XIV)

and pharmaceutically acceptable salts thereof, where:

Compound	R_1	R_9
L1 (a) and (b)	$-CF_3$	-*tert*-butyl
L2 (a) and (b)	$-CF_3$	-*iso*-butyl
L3 (a) and (b)	$-CF_3$	-*sec*-butyl
L4 (a) and (b)	$-CF_3$	-cyclohexyl
L5 (a) and (b)	$-CF_3$	-*tert*-butoxy
L6 (a) and (b)	$-CF_3$	-*iso*-propoxy
L7 (a) and (b)	$-CF_3$	$-CF_3$
L8 (a) and (b)	$-CF_3$	$-CH_3$
L9 (a) and (b)	$-CF_3$	$-CH_2CF_3$
L10 (a) and (b)	$-CF_3$	$-OCF_3$
L11 (a) and (b)	$-CF_3$	$-OCH_3$
L12 (a) and (b)	$-CF_3$	-Cl
L13 (a) and (b)	$-CF_3$	-Br
L14 (a) and (b)	$-CF_3$	-I
L15 (a) and (b)	$-CF_3$	-n-butyl
L16 (a) and (b)	$-CF_3$	-n-propyl
L17 (a) and (b)	$-CF_3$	-*iso*-propyl
L18 (a) and (b)	$-CF_3$	$-C_6H_5$
L19 (a) and (b)	$-CF_3$	-H
L20 (a) and (b)	$-NO_2$	-*tert*-butyl
L21 (a) and (b)	$-NO_2$	-*iso*-butyl
L22 (a) and (b)	$-NO_2$	-*sec*-butyl
L23 (a) and (b)	$-NO_2$	-cyclohexyl

L24 (a) and (b)	$-NO_2$	-*tert*-butoxy
L25 (a) and (b)	$-NO_2$	-*iso*-propoxy
L26 (a) and (b)	$-NO_2$	$-CF_3$
L27 (a) and (b)	$-NO_2$	$-CH_3$
L28 (a) and (b)	$-NO_2$	$-CH_2CF_3$
L29 (a) and (b)	$-NO_2$	$-OCF_3$
L30 (a) and (b)	$-NO_2$	$-OCH_3$
L31 (a) and (b)	$-NO_2$	-Cl
L32 (a) and (b)	$-NO_2$	-Br
L33 (a) and (b)	$-NO_2$	-I
L34 (a) and (b)	$-NO_2$	-n-butyl
L35 (a) and (b)	$-NO_2$	-n-propyl
L36 (a) and (b)	$-NO_2$	-*iso*-propyl
L37 (a) and (b)	$-NO_2$	$-C_6H_5$
L38 (a) and (b)	$-NO_2$	-H
L39 (a) and (b)	-CN	-*tert*-butyl
L40 (a) and (b)	-CN	-*iso*-butyl
L41 (a) and (b)	-CN	-*sec*-butyl
L42 (a) and (b)	-CN	-cyclohexyl
L43 (a) and (b)	-CN	-*tert*-butoxy
L44 (a) and (b)	-CN	-*iso*-propoxy
L45 (a) and (b)	-CN	$-CF_3$
L46 (a) and (b)	-CN	$-CH_3$
L47 (a) and (b)	-CN	$-CH_2CF_3$
L48 (a) and (b)	-CN	$-OCF_3$
L49 (a) and (b)	-CN	$-OCH_3$
L50 (a) and (b)	-CN	-Cl
L51 (a) and (b)	-CN	-Br
L52 (a) and (b)	-CN	-I
L53 (a) and (b)	-CN	-n-butyl
L54 (a) and (b)	-CN	-n-propyl
L55 (a) and (b)	-CN	-*iso*-propyl
L56 (a) and (b)	-CN	$-C_6H_5$
L57 (a) and (b)	-CN	-H

where "(a)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the R configuration, and "(b)" means that the carbon atom of the piperazino group to which the methyl group is attached is in the S configuration.

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4.4 DEFINITIONS

As used herein, the terms used above having following meaning:

"-(C_1-C_{10})alkyl" means a straight chain or branched non-cyclic hydrocarbon having from 1 to 10 carbon atoms. Representative straight chain -(C_1-C_{10})alkyls include -methyl, -ethyl, -n-propyl, -n-butyl, -n-pentyl, -n-hexyl, -n-heptyl, -n-octyl, -n-nonyl and -n-decyl. Representative branched -(C_1-C_{10})alkyls include -*iso*-propyl, -*sec*-butyl, -*iso*-butyl, -*tert*-butyl, -*iso*-pentyl, -*neo*-pentyl, 1-methylbutyl, 2-methylbutyl, 3-methylbutyl, 1,1-dimethylpropyl, 1,2-dimethylpropyl, 1-methylpentyl, 2-methylpentyl, 3-methylpentyl, 4-methylpentyl, 1-ethylbutyl, 2-ethylbutyl, 3-ethylbutyl, 1,1-dimethylbutyl, 1,2-dimethylbutyl, 1,3-dimethylbutyl, 2,2-dimethylbutyl, 2,3-dimethylbutyl, 3,3-dimethylbutyl, 1-methylhexyl, 2-methylhexyl, 3-methylhexyl, 4-methylhexyl, 5-methylhexyl, 1,2-dimethylpentyl, 1,3-dimethylpentyl, 1,2-dimethylhexyl, 1,3-dimethylhexyl, 3,3-dimethylhexyl, 1,2-dimethylheptyl, 1,3-dimethylheptyl, and 3,3-dimethylheptyl.

"-(C_1-C_6)alkyl" means a straight chain or branched non-cyclic hydrocarbon having from 1 to 6 carbon atoms. Representative straight chain -(C_1-C_6)alkyls include -methyl, -ethyl, -n-propyl, -n-butyl, -n-pentyl and -n-hexyl. Representative branched -(C_1-C_6)alkyls include -*iso*-propyl, -*sec*-butyl, -*iso*-butyl, -*tert*-butyl, -*iso*-pentyl, -*neo*-pentyl, 1-methylbutyl, 2-methylbutyl, 3-methylbutyl, 1,1-dimethylpropyl, 1,2-dimethylpropyl, 1-methylpentyl, 2-methylpentyl, 3-methylpentyl, 4-methylpentyl, 1-ethylbutyl, 2-ethylbutyl, 3-ethylbutyl, 1,1-dimethtylbutyl, 1,2-dimethylbutyl, 1,3-dimethylbutyl, 2,2-dimethylbutyl, 2,3-dimethylbutyl and 3,3-dimethylbutyl.

"-(C_2-C_{10})alkenyl" means a straight chain or branched non-cyclic hydrocarbon having from 2 to 10 carbon atoms and including at least one carbon-carbon double bond. Representative straight chain and branched (C_2-C_{10})alkenyls include -vinyl, -allyl, -1-butenyl, -2-butenyl, -*iso*-butylenyl, -1-pentenyl, -2-pentenyl, -3-methyl-1-butenyl, -2-methyl-2-butenyl, -2,3-dimethyl-2-butenyl, -1-hexenyl, -2-hexenyl, -3-hexenyl, -1-heptenyl, -2-heptenyl, -3-heptenyl, -1-octenyl, -2-octenyl, -3-octenyl, -1-nonenyl, -2-nonenyl, -3-nonenyl, -1-decenyl, -2-decenyl, -3-decenyl and the like.

"-(C_2-C_6)alkenyl" means a straight chain or branched non-cyclic hydrocarbon having from 2 to 6 carbon atoms and including at least one carbon-carbon double bond. Representative straight chain and branched (C_2-C_6)alkenyls include -vinyl, -allyl,

-1-butenyl, -2-butenyl, -*iso*-butylenyl, -1-pentenyl, -2-pentenyl, -3-methyl-1-butenyl, -2-methyl-2-butenyl, -2,3-dimethyl-2-butenyl, -1-hexenyl, 2-hexenyl, 3-hexenyl and the like.

"-(C_2-C_{10})alkynyl" means a straight chain or branched non-cyclic hydrocarbon having from 2 to 10 carbon atoms and including at lease one carbon-carbon triple bond. Representative straight chain and branched -(C_2-C_{10})alkynyls include -acetylenyl, -propynyl, -1-butynyl, -2-butynyl, -1-pentynyl, -2-pentynyl, -3-methyl-1-butynyl, -4-pentynyl, -1-hexynyl, -2-hexynyl, -5-hexynyl, -1-heptynyl, -2-heptynyl, -6-heptynyl, -1-octynyl, -2-octynyl, -7-octynyl, -1-nonynyl, -2-nonynyl, -8-nonynyl, -1-decynyl, -2-decynyl, -9-decynyl and the like.

"-(C_2-C_6)alkynyl" means a straight chain or branched non-cyclic hydrocarbon having from 2 to 6 carbon atoms and including at lease one carbon-carbon triple bond. Representative straight chain and branched (C_2-C_6)alkynyls include -acetylenyl, -propynyl, -1-butynyl, -2-butynyl, -1-pentynyl, -2-pentynyl, -3-methyl-1-butynyl, -4-pentynyl, -1-hexynyl, -2-hexynyl, -5-hexynyl and the like.

"-(C_3-C_{10})cycloalkyl" means a saturated cyclic hydrocarbon having from 3 to 10 carbon atoms. Representative (C_3-C_{10})cycloalkyls are -cyclopropyl, -cyclobutyl, -cyclopentyl, -cyclohexyl, -cycloheptyl, -cyclooctyl, -cyclononyl and -cyclodecyl.

"-(C_3-C_8)cycloalkyl" means a saturated cyclic hydrocarbon having from 3 to 8 carbon atoms. Representative (C_3-C_8)cycloalkyls include -cyclopropyl, -cyclobutyl, -cyclopentyl, -cyclohexyl, -cycloheptyl and -cyclooctyl.

"-(C_8-C_{14})bicycloalkyl" means a bi-cyclic hydrocarbon ring system having from 8 to 14 carbon atoms and at least one saturated cyclic alkyl ring. Representative -(C_8-C_{14})bicycloalkyls include -indanyl, -1,2,3,4-tetrahydronaphthyl, -5,6,7,8-tetrahydronaphthyl, -perhydronaphthyl and the like.

"-(C_8-C_{14})tricycloalkyl" means a tri-cyclic hydrocarbon ring system having from 8 to 14 carbon atoms and at least one saturated ring. Representative -(C_8-C_{14})tricycloalkyls include -pyrenyl, -1,2,3,4-tetrahydroanthracenyl, -perhydroanthracenyl -aceanthreneyl, -1,2,3,4-tetrahydropenanthrenyl, -5,6,7,8-tetrahydrophenanthrenyl, -perhydrophenanthrenyl and the like.

"-(C_5-C_{10})cycloalkenyl" means a cyclic non-aromatic hydrocarbon having at least one carbon-carbon double bond in the cyclic system and from 5 to 10 carbon atoms.

Representative (C_5-C_{10})cycloalkenyls include -cyclopentenyl, -cyclopentadienyl, -cyclohexenyl, -cyclohexadienyl,-cycloheptenyl, -cycloheptadienyl, -cycloheptatrienyl, -cyclooctenyl, -cyclooctadienyl, -cyclooctatrienyl, -cyclooctatetraenyl, -cyclononenyl -cyclononadienyl, -cyclodecenyl, -cyclodecadienyl and the like.

"-(C_5-C_8)cycloalkenyl" means a cyclic non-aromatic hydrocarbon having at least one carbon-carbon double bond in the cyclic system and from 5 to 8 carbon atoms. Representative (C_5-C_8)cycloalkenyls include -cyclopentenyl, -cyclopentadienyl, -cyclohexenyl, -cyclohexadienyl, -cycloheptenyl, -cycloheptadienyl, -cycloheptatrienyl, -cyclooctenyl, -cyclooctadienyl, -cyclooctatrienyl, -cyclooctatetraenyl and the like.

"-(C_8-C_{14})bicycloalkenyl" means a bi-cyclic hydrocarbon ring system having at least one carbon-carbon double bond in each ring and from 8 to 14 carbon atoms. Representative -(C_8-C_{14})bicycloalkenyls include -indenyl, -pentalenyl, -naphthalenyl, -azulenyl, -heptalenyl, -1,2,7,8-tetrahydronaphthalenyl and the like.

"-(C_8-C_{14})tricycloalkenyl" means a tri-cyclic hydrocarbon ring system having at least one carbon-carbon double bond in each ring and from 8 to 14 carbon atoms. Representative -(C_8-C_{14})tricycloalkenyls include -anthracenyl, -phenanthrenyl, -phenalenyl, -acenaphthalenyl, *as*-indacenyl, *s*-indacenyl and the like.

"-(3- to 7-membered)heterocycle" or "-(3- to 7-membered)heterocyclo" means a 3- to 7-membered monocyclic heterocyclic ring which is either saturated, unsaturated non-aromatic, or aromatic. A 3- or a 4-membered heterocycle can contain up to 3 heteroatoms, a 5-membered heterocycle can contain up to 4 heteroatoms, a 6-membered heterocycle can contain up to 6 heteroatoms, and a 7-membered heterocycle can contain up to 7 heteroatoms. Each heteroatom is independently selected from nitrogen, which can be quaternized; oxygen; and sulfur, including sulfoxide and sulfone. The -(3- to 7-membered)heterocycle can be attached via a nitrogen, sulfur, or carbon atom. Representative -(3- to 7-membered)heterocycles include pyridyl, furyl, thiophenyl, pyrrolyl, oxazolyl, imidazolyl, thiazolyl, thiadiazolyl, isoxazolyl, pyrazolyl, isothiazolyl, pyridazinyl, pyrimidinyl, pyrazinyl, triazinyl, morpholinyl, pyrrolidinonyl, pyrrolidinyl, piperidinyl, piperazinyl, hydantoinyl, valerolactamyl, oxiranyl, oxetanyl, tetrahydrofuranyl, tetrahydropyranyl, tetrahydropyrindinyl, tetrahydropyrimidinyl, tetrahydrothiophenyl, tetrahydrothiopyranyl and the like.

"-(3- to 5-membered)heterocycle" or "-(3- to 5-membered)heterocyclo" means a 3- to 5-membered monocyclic heterocyclic ring which is either saturated, unsaturated non-aromatic, or aromatic. A 3- or a 4-membered heterocycle can contain up to 3 heteroatoms, and a 5-membered heterocycle can contain up to 4 heteroatoms. Each heteroatom is independently selected from nitrogen, which can be quaternized; oxygen; and sulfur, including sulfoxide and sulfone. The -(3- to 5-membered)heterocycle can be attached via a nitrogen, sulfur, or carbon atom. Representative -(3- to 5-membered)heterocycles include furyl, thiophenyl, pyrrolyl, oxazolyl, imidazolyl, thiazolyl, isoxazolyl, pyrazolyl, isothiazolyl, triazinyl, pyrrolidinonyl, pyrrolidinyl, hydantoinyl, oxiranyl, oxetanyl, tetrahydrofuranyl, tetrahydrothiophenyl and the like.

"-(7- to 10-membered)bicycloheterocycle" or "-(7- to 10-membered)bicycloheterocyclo" means a 7- to 10-membered bicyclic, heterocyclic ring which is either saturated, unsaturated non-aromatic, or aromatic. A -(7- to 10-membered)bicycloheterocycle contains from 1 to 4 heteroatoms independently selected from nitrogen, which can be quaternized; oxygen; and sulfur, including sulfoxide and sulfone. The -(7- to 10-membered)bicycloheterocycle can be attached via a nitrogen, sulfur, or carbon atom. Representative -(7- to 10-membered)bicycloheterocycles include -quinolinyl, -isoquinolinyl, -chromonyl, -coumarinyl, -indolyl, -indolizinyl, -benzo[b]furanyl, -benzo[b]thiophenyl, -indazolyl, -purinyl, -4H-quinolizinyl, -isoquinolyl, -quinolyl, -phthalazinyl, -naphthyridinyl, -carbazolyl, -β-carbolinyl and the like.

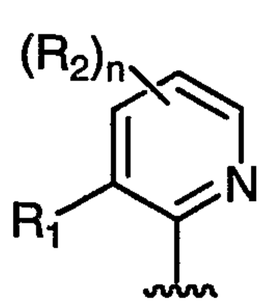
"-(C_{14})aryl" means a 14-membered aromatic carbocyclic moiety such as -anthryl or -phenanthryl.

"-(5- to 10-membered)heteroaryl" means an aromatic heterocycle ring of 5 to 10 members, including both mono- and bicyclic ring systems, where at least one carbon atom of one or both of the rings is replaced with a heteroatom independently selected from nitrogen, oxygen and sulfur. In one embodiment, one of the -(5- to 10-membered)heteroaryl's rings contain at least one carbon atom. In another embodiment, both of the -(5- to 10-membered)heteroaryl's rings contain at least one carbon atom. Representative -(5- to 10-membered)heteroaryls include pyridyl, furyl, benzofuranyl, thiophenyl, benzothiophenyl, quinolinyl, pyrrolyl, indolyl, oxazolyl, benzoxazolyl, imidazolyl, benzimidazolyl, thiazolyl, benzothiazolyl, isoxazolyl, pyrazolyl, isothiazolyl,

pyridazinyl, pyrimidinyl, pyrazinyl, thiadiazolyl, triazinyl, cinnolinyl, phthalazinyl, and quinazolinyl.

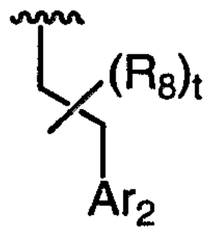
"-Halogen" or "-halo" means -F, -Cl, -Br or -I.

The phrase "pyridyl group" means



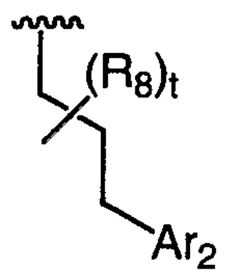
where R_1, R_2, and n are defined above for the 3-substituted Pyridyl Compounds of formulas (I) and (II).

The phrase "phenethyl group" means an ethylene group attached to a terminal Ar_2 group, where one or each of two hydrogens of the ethylene group can optionally be substituted with an R_8 group. A phenethyl group is depicted below:



where R_8 Ar_2, and t are defined above for the 3-substituted Pyridyl Compounds of formulas (I).

The phrase "phenpropyl group" an n-propylene group attached to a terminal Ar_2 group, where one or each of two hydrogens of the n-propylene group can optionally be substituted with an R_8 group. A phenpropyl group is depicted below



where R_8, Ar_2, and t are defined above for the 3-substituted Pyridyl Compounds of formulas (II).

The phrase "effective amount," when used in connection with a 3-substituted Pyridyl Compound means an amount effective for: (a) treating or preventing a Condition; or (b) inhibiting VR1, mGluR1, or mGluR5 function in a cell.

The phrase "effective amount," when used in connection with the another therapeutic agent means an amount for providing the therapeutic effect of the therapeutic agent.

The term "animal," includes, but is not limited to, a cow, monkey, chimpanzee, baboon, horse, sheep, pig, chicken, turkey, quail, cat, dog, mouse, rat, rabbit, guinea pig and human.

The phrase "pharmaceutically acceptable salt," as used herein, is any pharmaceutically acceptable salt that can be prepared from a 3-substituted Pyridyl Compound, including a salt formed from an acid and a basic functional group, such as a nitrogen group, of one of the 3-substituted Pyridyl Compounds. Illustrative salts include, but are not limited, to sulfate, citrate, acetate, oxalate, chloride, bromide, iodide, nitrate, bisulfate, phosphate, acid phosphate, isonicotinate, lactate, salicylate, acid citrate, tartrate, oleate, tannate, pantothenate, bitartrate, ascorbate, succinate, maleate, gentisinate, fumarate, gluconate, glucaronate, saccharate, formate, benzoate, glutamate, methanesulfonate, ethanesulfonate, benzenesulfonate, *p*-toluenesulfonate, and pamoate (*i.e.*, 1,1'-methylene-bis-(2-hydroxy-3-naphthoate)) salts. The term "pharmaceutically acceptable salt" also refers to a salt prepared from a 3-substituted Pyridyl Compound having an acidic functional group, such as a carboxylic acid functional group, and a pharmaceutically acceptable inorganic or organic base. Suitable bases include, but are not limited to, hydroxides of alkali metals such as sodium, potassium, and lithium; hydroxides of alkaline earth metal such as calcium and magnesium; hydroxides of other metals, such as aluminum and zinc; ammonia, and organic amines, such as unsubstituted or hydroxy-substituted mono-, di-, or trialkylamines; dicyclohexylamine; tributyl amine; pyridine; N-methyl,N-ethylamine; diethylamine; triethylamine; mono-, bis-, or tris-(2-hydroxy-lower alkyl amines), such as mono-, bis-, or tris-(2-hydroxyethyl)amine, 2-hydroxy-*tert*-butylamine, or tris-(hydroxymethyl)methylamine, N,N-di-lower alkyl-N-(hydroxy lower alkyl)-amines, such as N,N-dimethyl-N-(2-hydroxyethyl)amine, or tri-(2-hydroxyethyl)amine; N-methyl-D-glucamine; and amino acids such as arginine, lysine, and the like.

When a first group is "substituted with one or more" second groups, each of one or more of the first group's hydrogen atoms is replaced with a second group.

In one embodiment, each carbon atom of a first group is independently substituted with one or two second groups. In another embodiment, each carbon atom of a first group is independently substituted with only one second group.

The term "UI" means urinary incontinence.

The term "IBD" means inflammatory-bowel disease.

The term "IBS" means irritable-bowel syndrome.

The term "ALS" means amyotrophic lateral sclerosis.

The term "DMSO" means dimethyl sulfoxide.

The term "DMF" means dimethyl formamide.

The term "DCM" means dichloromethane.

The term "DIEA" means diisopropylethylamine.

The phrases "treatment of," "treating" and the like include the amelioration or cessation of a Condition or a symptom thereof.

In one embodiment, treating includes inhibiting, for example, decreasing the overall frequency of episodes of a Condition or a symptom thereof.

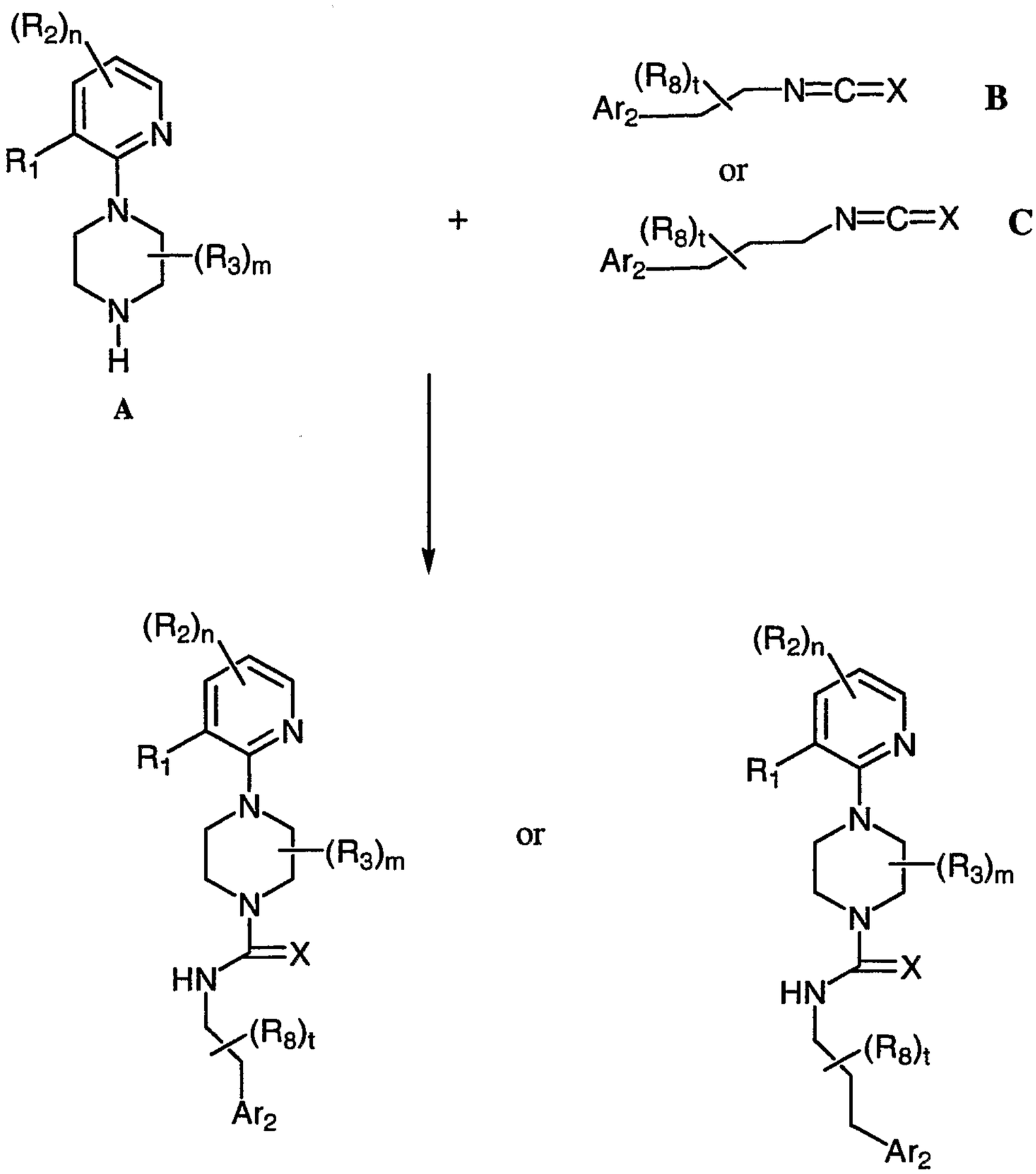
The phrases "prevention of," "preventing" and the like include the avoidance of the onset of a Condition or a symptom thereof.

4.5 METHODS FOR MAKING THE 3-SUBSTITUTED PYRIDYL COMPOUNDS

The 3-substituted Pyridyl Compounds can be made using conventional organic synthesis or by the following illustrative methods shown in the schemes below.

The 3-substituted Pyridyl Compounds of Formula (I) and (II) can be obtained using conventional organic syntheses or by the following illustrative methods shown in below in Scheme **1**.

Scheme 1



3-substituted Pyridyl Compound

X = S or O

where Ar_2, R_1, R_2, R_3, R_8, n, m, and t are as defined above.

Compound **A** is reacted with an isocyanate or isothiocyanate of formula **A** or **B** in a suitable solvent, preferably DCM, at a suitable temperature, preferably at about 25°C, to provide the 3-substituted Pyridyl Compound where X = O and X = S, respectively.

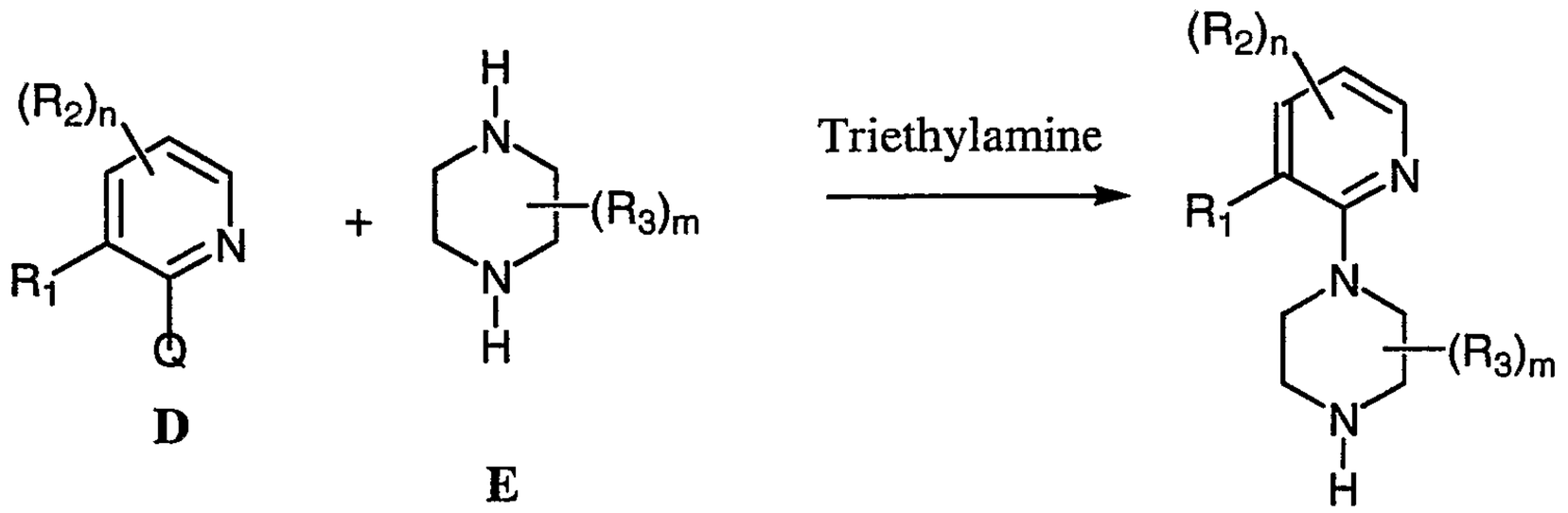
If the 3-substituted Pyridyl Compound is substituted with a hydroxyl group or thiol group, then the hydroxyl or thiol group of compound **A** is preferably protected with a suitable protecting group before being reacted with the isocyanate or isothiocyanate. Suitable protecting groups for hydroxyl group include, but are not limited to, methyl ether, methoxymethyl ether, methoxythiomethyl ether, 2-methoxyethoxymethyl ether,

bis(2-chloroethoxy)ethyl ether, tetrahydropyranyl ether, tetrahydrothiopyranyl ether, 4-methoxytetrahydropyranyl ether, methoxytetrahydrothiopyranyl ether, tetrahydrofuranyl ether, tetrahydrothiofuranyl ether, 1-ethoxyethyl ether, 1-methyl-1-methoxyethyl ether, 2-(phenylselenyl ether), *tert*-butyl ether, allyl ether, benzyl ether, *o*-nitrobenzyl ether, triphenylmethyl ether, *o*-napthyldiphenylmethyl ether, *p*-methoxydiphenylmethyl ether, 9-(9-phenyl-10-oxo)anthryl ether (tritylone), trimethylsilyl ether, isopropyldimethylsilyl ether, *tert*-butyldimethylsilyl ether, *tert*-butyldiphenylsilyl ether, tribenzylsilyl ether, triisopropylsilyl ether, formate ester, acetate ester, trichloroacetate ester, phenoxyacetate ester, isobutyrate ester, pivaloate ester, adamantoate ester, benzoate ester, 2,4,6-trimethyl (mesitoate) ester, methyl carbonate, 2,2,2-trichlorocarbonate, allyl carbonate, p-nitrophenyl carbonate, benzyl carbonate, p-nitrobenzyl carbonate, S-benzylthiocarbonate, N-phenylcarbamate, nitrate ester, and 2,4-dinitrophenylsulfenate ester (*See, e.g.*, T.W. Greene, *Protective Groups in Organic Synthesis* 10-72 (1981)).

Suitable protecting groups for a thiol group include, but are not limited to, S-benzyl thioether, S-*p*-methoxybenzyl thioether, S-*p*-nitrobenzyl thioether, S-4-picolyl thioether, S-2-picolyl N-oxide thioether, S-9-anthrylmethyl thioether, S-diphenylmethyl thioether, S-di(*p*-methoxyphenyl)methyl thioether, S-triphenylmethyl thioether, S-2,4-dinitrophenyl thioether, S-*tert*-butyl thioether, S-*iso*-butoxymethyl hemithioacetal, S-2-tetrahydropyranyl hemithioacetal, S-acetamidomethyl aminothioacetal, S-cyanomethyl thioether, S-2-nitro-1-phenylethyl thioether, S-2,2-bis(carboethoxy)ethyl thioether, S-benzoyl derivative, S-(N-ethylcarbamate), and S-ethyldisulfide. *Id.* at 193-217.

The compound of formula **A** can be prepared by reacting a 3-halo-substituted pyridine of formula **D** with a piperazine **E** in chloroform, in the presence of triethylamine at a temperature of about 50°C as shown below in Scheme **2**.

Scheme 2

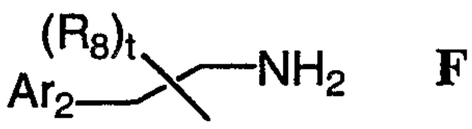


where R_1, R_2, R_3, R_8, n, and m are defined above and Q is I, Br, Cl, or F.

A representative procedure for reacting a 3-halo-pyridines with piperazine is provided in E. J. Jacobsen *et al.*, *J. Med. Chem.* 1145-1151 (1990).

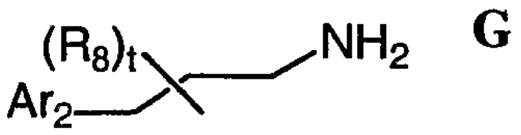
The substituted 3-halo-pyridines **D** are commercially available or can be prepared by methods known to those skilled in the art.

Isocyanates **B** and **C** are commercially available or preparable by reacting an amine of formula **F** or **G**, shown below,



F

or



G

with phosgene according to well-known methods (*See, e.g.*, H. Eckert *et al.*, *Angew. Chem. Int. Ed. Engl.* 26:894 (1987); H. Eckert, Ger. Offen. DE 3 440 141; *Chem Abstr.* 106:4294d (1987); and L. Contarca *et al.*, *Synthesis* 553-576 (1996)).

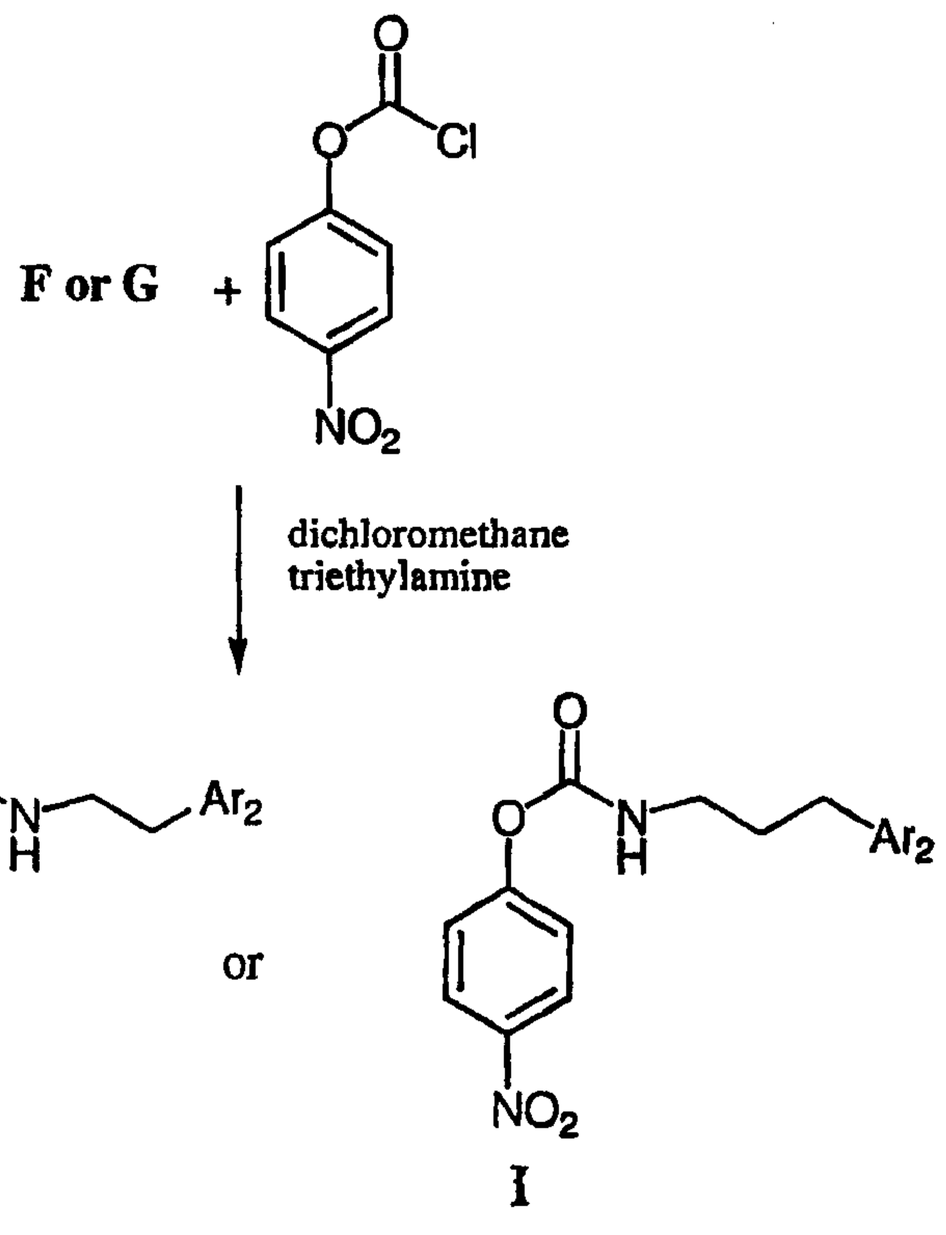
Typically, a solution of triphosgene (0.3 eq) in 1,2-dichloroethane (0.3 M) is slowly added to a stirred solution of the amine (1.0 eq.) in 1,2-dichloroethane (0.3 M) at about 25°C. The reaction mixture is then stirred at about 25°C for about 10 min. and the temperature then raised to about 70°C. After stirring at about 70°C for about 3 h, the reaction mixture is cooled to about 25°C, filtered, and the filtrate concentrated to give the desired isocyanate.

Isothiocyanates **B** and **C** are commercially available or preparable by reacting an amine of formula **F** or **G** with thiophosgene (*See, e.g.*, *Tetrahedron Lett.*, 41(37):7207-7209 (2000); *Synlett* 11:1784-1786 (1999); *Heterocycles* 32:2343-2355 (1991); *Org. Prep., Proced., Int.* 23(6):729-734 (1991); *J. Heterocycle Chem.* 28(4):1091-1097 (1991); *J. Fluorine Chem.* 41(3):303-310 (1988); *J. Med. Chem.* 32(6):1173-1176 and 1392-1398 (1989); and *Tetrahedron Lett.* 42(32):5414-5416 (2001).

Alternatively, isothiocyanates **B** and **C** can be prepared by reacting an amine of formula **F** or **G** with carbon disulfide in the presence of triethylamine in tetrahydrofuran, followed by reaction with hydrogen peroxide and hydrochloric acid in water (*See, e.g.*, *J. Org. Chem.*, 62 (13), 4539-4540 (1997)).

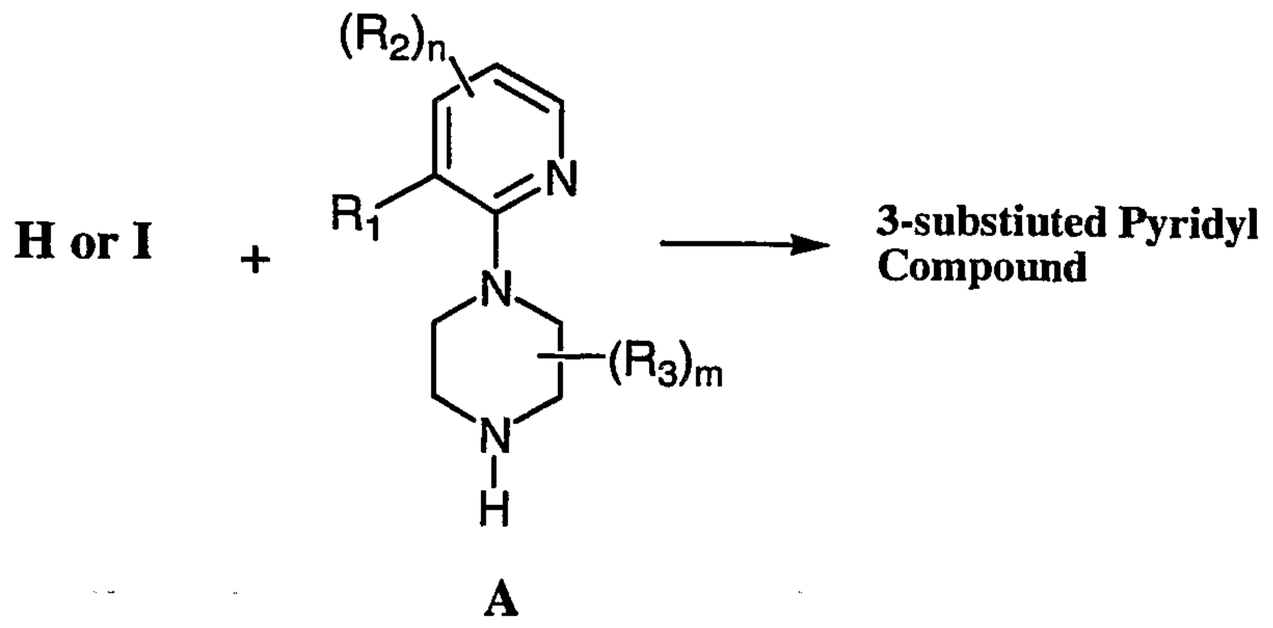
The 3-substituted Pyridyl Compounds of Formula (I) and (II) where X is O can also be prepared by reacting an amine of formula **F** or **G** with 4-nitrophenylchloroformate (commercially available from Sigma-Aldrich, St. Louis, MO to provide a carbamate, Compound **H** or **I**, and then reacting Compound **H** or **I** with Compound **A** as shown below in Schemes 3 and 4 (*See, e.g.*, *J. Org. Chem.* 63(23):8515-8521 (1998) and European Patent Publication No. 549 039).

Scheme 3



H **I**

Scheme 4



where R_1, R_2, R_3, n, and m are defined above for the Pyridyl Compounds of Formula (I) and (II).

4.6 THERAPEUTIC USES OF THE PYRADIZINYLPIPERAZINE COMPOUNDS

In accordance with the invention, the 3-substituted Pyridyl Compounds are administered to an animal in need of treatment or prevention of a Condition.

In one embodiment, an effective amount of a 3-substituted Pyridyl Compound can be used to treat or prevent any condition treatable or preventable by inhibiting VR1. Examples of conditions that are treatable or preventable by inhibiting VR1 include, but are not limited to, pain, UI, an ulcer, IBD, and IBS.

In another embodiment, an effective amount of a 3-substituted Pyridyl Compound can be used to treat or prevent any condition treatable or preventable by inhibiting mGluR5. Examples of conditions that are treatable or preventable by inhibiting mGluR5 include, but are not limited to, pain, an addictive disorder, Parkinson's disease, parkinsonism, anxiety, a pruritic condition, and psychosis.

In another embodiment, an effective amount of a 3-substituted Pyridyl Compound can be used to treat or prevent any condition treatable or preventable by inhibiting mGluR1. Examples of conditions that are treatable or preventable by inhibiting mGluR1 include, but are not limited to, pain, UI, an addictive disorder, Parkinson's disease, parkinsonism, anxiety, epilepsy, stroke, a seizure, a pruritic condition, psychosis, a cognitive disorder, a memory deficit, restricted brain function, Huntington's chorea, ALS, dementia, retinopathy, a muscle spasm, a migraine, vomiting, dyskinesia, and depression.

The 3-substituted Pyridyl Compounds can be used to treat or prevent acute or chronic pain. Examples of pain treatable or preventable using the 3-substituted Pyridyl Compounds include, but are not limited to, cancer pain, labor pain, myocardial infarction pain, pancreatic pain, colic pain, post-operative pain, headache pain, muscle pain, arthritic pain, and pain associated with a periodontal disease, including gingivitis and periodontitis.

The 3-substituted Pyridyl Compounds can also be used for treating or preventing pain associated with inflammation or with an inflammatory disease in an animal. Such pain can arise where there is an inflammation of the body tissue which can be a local inflammatory response and/or a systemic inflammation. For example, the 3-substituted Pyridyl Compounds can be used to treat or prevent pain associated with inflammatory diseases including, but not limited to: organ transplant rejection; reoxygenation injury resulting from organ transplantation (*see* Grupp *et al.*, J. Mol, Cell Cardiol. 31:297-303 (1999)) including, but not limited to, transplantation of the heart, lung, liver, or kidney; chronic inflammatory diseases of the joints, including arthritis, rheumatoid arthritis, osteoarthritis and bone diseases associated with increased bone resorption; inflammatory bowel diseases, such as ileitis, ulcerative colitis, Barrett's syndrome, and Crohn's disease; inflammatory lung diseases, such as asthma, adult respiratory distress syndrome, and chronic obstructive airway disease; inflammatory diseases of the eye, including corneal dystrophy, trachoma, onchocerciasis, uveitis, sympathetic ophthalmitis and endophthalmitis; chronic inflammatory disease of the gum, including gingivitis and periodontitis; tuberculosis; leprosy; inflammatory diseases of the kidney, including uremic complications, glomerulonephritis and nephrosis; inflammatory disease of the skin, including sclerodermatitis, psoriasis and eczema; inflammatory diseases of the central nervous system, including chronic demyelinating diseases of the nervous system, multiple sclerosis, AIDS-related neurodegeneration and Alzheimer 's disease, infectious meningitis, encephalomyelitis, Parkinson's disease, Huntington's disease, amyotrophic lateral sclerosis and viral or autoimmune encephalitis; autoimmune diseases, including Type I and Type II diabetes mellitus; diabetic complications, including, but not limited to, diabetic cataract, glaucoma, retinopathy, nephropathy (such as microaluminuria and progressive diabetic nephropathy), polyneuropathy, mononeuropathies, autonomic neuropathy, gangrene of the feet, atherosclerotic coronary arterial disease, peripheral arterial disease, nonketotic hyperglycemic-hyperosmolar coma, foot ulcers, joint

problems, and a skin or mucous membrane complication (such as an infection, a shin spot, a candidal infection or necrobiosis lipoidica diabeticorum); immune-complex vasculitis, and systemic lupus erythematosus (SLE); inflammatory disease of the heart, such as cardiomyopathy, ischemic heart disease hypercholesterolemia, and artherosclerosis; as well as various other diseases that can have significant inflammatory components, including preeclampsia, chronic liver failure, brain and spinal cord trauma, and cancer. The 3-substituted Pyridyl Compounds can also be used for inhibiting, treating, or preventing pain associated with inflammatory disease that can, for example, be a systemic inflammation of the body, exemplified by gram-positive or gram negative shock, hemorrhagic or anaphylactic shock, or shock induced by cancer chemotherapy in response to pro-inflammatory cytokines, *e.g.*, shock associated with pro-inflammatory cytokines. Such shock can be induced, *e.g.*, by a chemotherapeutic agent that is administered as a treatment for cancer.

The 3-substituted Pyridyl Compounds can be used to treat or prevent UI. Examples of UI treatable or preventable using the 3-substituted Pyridyl Compounds include, but are not limited to, urge incontinence, stress incontinence, overflow incontinence, neurogenic incontinence, and total incontinence.

The 3-substituted Pyridyl Compounds can be used to treat or prevent an ulcer. Examples of ulcers treatable or preventable using the 3-substituted Pyridyl Compounds include, but are not limited to, a duodenal ulcer, a gastric ulcer, a marginal ulcer, an esophageal ulcer, or a stress ulcer.

The 3-substituted Pyridyl Compounds can be used to treat or prevent IBD, including Crohn's disease and ulcerative colitis.

The 3-substituted Pyridyl Compounds can be used to treat or prevent IBS. Examples of IBS treatable or preventable using the 3-substituted Pyridyl Compounds include, but are not limited to, spastic-colon-type IBS and constipation-predominant IBS.

The 3-substituted Pyridyl Compounds can be used to treat or prevent an addictive disorder, including but not limited to, an eating disorder, an impulse-control disorder, an alcohol-related disorder, a nicotine-related disorder, an amphetamine-related disorder, a cannabis-related disorder, a cocaine-related disorder, an hallucinogen-related disorder, an inhalant-related disorders, and an opioid-related disorder, all of which are further sub-classified as listed below.

Eating disorders include, but are not limited to, Bulimia Nervosa, Nonpurging Type; Bulimia Nervosa, Purging Type; Anorexia; and Eating Disorder not otherwise specified (NOS).

Impulse control disorders include, but are not limited to, Intermittent Explosive Disorder, Kleptomania, Pyromania, Pathological Gambling, Trichotillomania, and Impulse Control Disorder not otherwise specified (NOS).

Alcohol-related disorders include, but are not limited to, Alcohol Induced Psychotic Disorder with delusions, Alcohol Abuse, Alcohol Intoxication, Alcohol Withdrawal, Alcohol Intoxication Delirium, Alcohol Withdrawal Delirium, Alcohol Induced Persisting Dementia, Alcohol Induced Persisting Amnestic Disorder, Alcohol Dependence, Alcohol Induced Psychotic Disorder with hallucinations, Alcohol Induced Mood Disorder, Alcohol Induced Anxiety Disorder, Alcohol Induced Sexual Dysfunction, Alcohol Induced Sleep Disorder, and Alcohol Related Disorder not otherwise specified (NOS).

Nicotine-related disorders include, but are not limited to, Nicotine Dependence, Nicotine Withdrawal, and Nicotine Related Disorder not otherwise specified (NOS).

Amphetamine-related disorders include, but are not limited to, Amphetamine Dependence, Amphetamine Abuse, Amphetamine Intoxication, Amphetamine Withdrawal, Amphetamine Intoxication Delirium, Amphetamine Induced Psychotic Disorder with delusions, Amphetamine Induced Psychotic Disorders with hallucinations, Amphetamine Induced Mood Disorder, Amphetamine Induced Anxiety Disorder, Amphetamine Induced Sexual Dysfunction, Amphetamine Induced Sleep Disorder, and Amphetamine Related Disorder not otherwise specified (NOS).

Cannabis-related disorders include, but are not limited to, Cannabis Dependence, Cannabis Abuse, Cannabis Intoxication, Cannabis Intoxication Delirium, Cannabis Induced Psychotic Disorder with delusions, Cannabis Induced Psychotic Disorder with hallucinations, Cannabis Induced Anxiety Disorder, and Cannabis Related Disorder not otherwise specified (NOS).

Cocaine-related disorders include, but are not limited to, Cocaine Dependence, Cocaine Abuse, Cocaine Intoxication, Cocaine Withdrawal, Cocaine Intoxication Delirium, Cocaine Induced Psychotic Disorder with delusions, Cocaine Induced Psychotic Disorders with hallucinations, Cocaine Induced Mood Disorder, Cocaine

Induced Anxiety Disorder, Cocaine Induced Sexual Dysfunction, Cocaine Induced Sleep Disorder, and Cocaine Related Disorder not otherwise specified (NOS).

Hallucinogen-related disorders include, but are not limited to, Hallucinogen Dependence, Hallucinogen Abuse, Hallucinogen Intoxication, Hallucinogen Withdrawal, Hallucinogen Intoxication Delirium, Hallucinogen Persisting Perception Disorder (Flashbacks), Hallucinogen Induced Psychotic Disorder with delusions, Hallucinogen Induced Psychotic Disorders with hallucinations, Hallucinogen Induced Mood Disorder, Hallucinogen Induced Anxiety Disorder, Hallucinogen Induced Sexual Dysfunction, Hallucinogen Induced Sleep Disorder, and Hallucinogen Related Disorder not otherwise specified (NOS).

Inhalant-related disorders include, but are not limited to, Inhalant Dependence, Inhalant Abuse, Inhalant Intoxication, Inhalant Intoxication Delirium, Inhalant Induced Psychotic Disorder with delusions, Inhalant Induced Psychotic Disorder with hallucinations, Inhalant Induced Anxiety Disorder, and Inhalant Related Disorder not otherwise specified (NOS).

Opioid-related disorders include, but are not limited to, Opioid Dependence, Opioid Abuse, Opioid Withdrawal, Opioid Intoxication, Opioid Intoxication Delirium, Opioid Induced Psychotic Disorder with delusions, Opioid Induced Psychotic Disorder with hallucinations, Opioid Induced Anxiety Disorder, and Opioid Related Disorder not otherwise specified (NOS).

The 3-substituted Pyridyl Compounds can be used to treat or prevent Parkinson's disease and parkinsonism and the symptoms associated with Parkinson's disease and parkinsonism, including but not limited to, bradykinesia, muscular rigidity, resting tremor, and impairment of postural balance.

The 3-substituted Pyridyl Compounds can be used to treat or prevent generalized anxiety or severe anxiety and the symptoms associated with anxiety, including but not limited to, restlessness; tension; tachycardia; dyspnea; depression, including chronic "neurotic" depression; panic disorder; agoraphobia and other specific phobias; eating disorders; and personality disorders.

The 3-substituted Pyridyl Compounds can be used to treat or prevent epilepsy, including but not limited to, partial epilepsy, generalized epilepsy, and the symptoms associated with epilepsy, including but not limited to, simple partial seizures, jacksonian

seizures, complex partial (psychomotor) seizures, convulsive seizures (grand mal or tonic-clonic seizures), petit mal (absence) seizures, and status epilepticus.

The 3-substituted Pyridyl Compounds can be used to treat or prevent a stroke, including but not limited to, an ischemic stroke and a hemorrhagic stroke.

The 3-substituted Pyridyl Compounds can be used to treat or prevent a seizure, including but not limited to, infantile spasms, febrile seizures, and epileptic seizures.

The 3-substituted Pyridyl Compounds can be used to treat or prevent a pruritic condition, including but not limited to, pruritus caused by dry skin, scabies, dermatitis, herpetiformis, atopic dermatitis, pruritus vulvae et ani, miliaria, insect bites, pediculosis, contact dermatitis, drug reactions, urticaria, urticarial eruptions of pregnancy, psoriasis, lichen planus, lichen simplex chronicus, exfoliative dermatitis, folliculitis, bullous pemphigoid, or fiberglass dermatitis.

The 3-substituted Pyridyl Compounds can be used to treat or prevent psychosis, including but not limited to, schizophrenia, including paranoid schizophrenia, hebephrenic or disorganized schizophrenia, catatonic schizophrenia, undifferentiated schizophrenia, negative or deficit subtype schizophrenia, and non-deficit schizophrenia; a delusional disorder, including erotomanic subtype delusional disorder, grandiose subtype delusional disorder, jealous subtype delusional disorder, persecutory subtype delusional disorder, and somatic subtype delusional disorder; and brief psychosis.

The 3-substituted Pyridyl Compounds can be used to treat or prevent a cognitive disorder, including but not limited to, delirium and dementia such as multi-infarct dementia, dementia pugilistica, dementia caused by AIDS, and dementia caused by Alzheimer's disease.

The 3-substituted Pyridyl Compounds can be used to treat or prevent a memory deficiency, including but not limited to, dissociative amnesia and dissociative fugue.

The 3-substituted Pyridyl Compounds can be used to treat or prevent restricted brain function, including but not limited to, that caused by surgery or an organ transplant, restricted blood supply to the brain, a spinal cord injury, a head injury, hypoxia, cardiac arrest, or hypoglycemia.

The 3-substituted Pyridyl Compounds can be used to treat or prevent Huntington's chorea.

The 3-substituted Pyridyl Compounds can be used to treat or prevent ALS.

The 3-substituted Pyridyl Compounds can be used to treat or prevent retinopathy, including but not limited to, arteriosclerotic retinopathy, diabetic arteriosclerotic retinopathy, hypertensive retinopathy, non-proliferative retinopathy, and proliferative retinopathy.

The 3-substituted Pyridyl Compounds can be used to treat or prevent a muscle spasm.

The 3-substituted Pyridyl Compounds can be used to treat or prevent a migraine.

The 3-substituted Pyridyl Compounds can be used to treat, inhibit, or prevent vomiting, including but not limited to, nausea vomiting, dry vomiting (retching), and regurgitation.

The 3-substituted Pyridyl Compounds can be used to treat or prevent dyskinesia, including but not limited to, tardive dyskinesia and biliary dyskinesia.

The 3-substituted Pyridyl Compounds can be used to treat or prevent depression, including but not limited to, major depression and bipolar disorder.

Applicants believe that the 3-substituted Pyridyl Compounds are antagonists for VR1.

The invention also relates to methods for inhibiting VR1 function in a cell, comprising contacting a cell capable of expressing VR1 with an effective amount of a 3-substituted Pyridyl Compound. This method can be used in vitro, for example, as an assay to select cells that express VR1 and, accordingly, are useful as part of an assay to select compounds useful for treating or preventing pain, UI, an ulcer, IBD, or IBS. The method is also useful for inhibiting VR1 function in a cell in vivo, in an animal, a human in one embodiment, by contacting a cell, in an animal, with an effective amount of a 3-substituted Pyridyl Compound. In one embodiment, the method is useful for treating or preventing pain in an animal. In another embodiment, the method is useful for treating or preventing UI in an animal. In another embodiment, the method is useful for treating or preventing an ulcer in an animal. In another embodiment, the method is useful for treating or preventing IBD in an animal. In another embodiment, the method is useful for treating or preventing IBS in an animal.

Examples of tissue comprising cells capable of expressing VR1 include, but are not limited to, neuronal, brain, kidney, urothelium, and bladder tissue. Methods for assaying cells that express VR1 are known in the art.

Applicants believe that the 3-substituted Pyridyl Compounds are antagonists for mGluR5.

The invention also relates to methods for inhibiting mGluR5 function in a cell, comprising contacting a cell capable of expressing mGluR5 with an amount of a 3-substituted Pyridyl Compound effective to inhibit mGluR5 function in the cell. This method can be used in vitro, for example, as an assay to select cells that express mGluR5 and, accordingly, are useful as part of an assay to select compounds useful for treating or preventing pain, an addictive disorder, Parkinson's disease, parkinsonism, anxiety, a pruritic condition, or psychosis. The method is also useful for inhibiting mGluR5 function in a cell in vivo, in an animal, a human in one embodiment, by contacting a cell, in an animal, with an amount of a 3-substituted Pyridyl Compound effective to inhibit mGluR5 function in the cell. In one embodiment, the method is useful for treating or preventing pain in an animal in need thereof. In another embodiment, the method is useful for treating or preventing an addictive disorder in an animal in need thereof. In another embodiment, the method is useful for treating or preventing Parkinson's disease in an animal in need thereof. In another embodiment, the method is useful for treating or preventing parkinsonism in an animal in need thereof. In another embodiment, the method is useful for treating or preventing anxiety in an animal in need thereof. In another embodiment, the method is useful for treating or preventing a pruritic condition in an animal in need thereof. In another embodiment, the method is useful for treating or preventing psychosis in an animal in need thereof.

Examples of cells capable of expressing mGluR5 are neuronal and glial cells of the central nervous system, particularly the brain, especially in the nucleus accumbens. Methods for assaying cells that express mGluR5 are known in the art.

Applicants believe that the 3-substituted Pyridyl Compounds are antagonists for mGluR1.

The invention also relates to methods for inhibiting mGluR1 function in a cell, comprising contacting a cell capable of expressing mGluR1 with an amount of a 3-substituted Pyridyl Compound effective to inhibit mGluR1 function in the cell. This

method can be used in vitro, for example, as an assay to select cells that express mGluR1 and, accordingly, are useful as part of an assay to select compounds useful for treating or preventing pain, UI, an addictive disorder, Parkinson's disease, parkinsonism, anxiety, epilepsy, stroke, a seizure, a pruritic condition, psychosis, a cognitive disorder, a memory deficit, restricted brain function, Huntington's chorea, ALS, dementia, retinopathy, a muscle spasm, a migraine, vomiting, dyskinesia, or depression. The method is also useful for inhibiting mGluR1 function in a cell in vivo, in an animal, a human in one embodiment, by contacting a cell, in an animal, with an amount of a 3-substituted Pyridyl Compound effective to inhibit mGluR1 function in the cell. In one embodiment, the method is useful for treating or preventing pain in an animal in need thereof. In another embodiment, the method is useful for treating or preventing UI in an animal in need thereof. In another embodiment, the method is useful for treating or preventing an addictive disorder in an animal in need thereof. In another embodiment, the method is useful for treating or preventing Parkinson's disease in an animal in need thereof. In another embodiment, the method is useful for treating or preventing parkinsonism in an animal in need thereof. In another embodiment, the method is useful for treating or preventing anxiety in an animal in need thereof. In another embodiment, the method is useful for treating or preventing epilepsy in an animal in need thereof. In another embodiment, the method is useful for treating or preventing stroke in an animal in need thereof. In another embodiment, the method is useful for treating or preventing a seizure in an animal in need thereof. In another embodiment, the method is useful for treating or preventing a pruritic condition in an animal in need thereof. In another embodiment, the method is useful for treating or preventing psychosis in an animal in need thereof. In another embodiment, the method is useful for treating or preventing a cognitive disorder in an animal in need thereof. In another embodiment, the method is useful for treating or preventing a memory deficit in an animal in need thereof. In another embodiment, the method is useful for treating or preventing restricted brain function in an animal in need thereof. In another embodiment, the method is useful for treating or preventing Huntington's chorea in an animal in need thereof. In another embodiment, the method is useful for treating or preventing ALS in an animal in need thereof. In another embodiment, the method is useful for treating or preventing dementia in an animal in need thereof. In another embodiment, the method is useful for treating or preventing retinopathy in an animal in need thereof. In another embodiment, the method is useful for treating or preventing a muscle spasm in an animal in need thereof. In

another embodiment, the method is useful for treating or preventing a migraine in an animal in need thereof. In another embodiment, the method is useful for treating, preventing, or inhibiting vomiting in an animal in need thereof. In another embodiment, the method is useful for treating or preventing dyskinesia in an animal in need thereof. In another embodiment, the method is useful for treating or preventing depression in an animal in need thereof.

Examples of cells capable of expressing mGluR1 include, but are not limited to, cerebellar Purkinje neuron cells, Purkinje cell bodies (punctate), cells of spine(s) of the cerebellum; neurons and neurophil cells of olfactory-bulb glomeruli; cells of the superficial layer of the cerebral cortex; hippocampus cells; thalamus cells; superior colliculus cells; and spinal trigeminal nucleus cells. Methods for assaying cells that express mGluR1 are known in the art.

4.6.1 THERAPEUTIC/PROPHYLACTIC ADMINISTRATION AND COMPOSITIONS OF THE INVENTION

Due to their activity, the 3-substituted Pyridyl Compounds are advantageously useful in veterinary and human medicine. As described above, the 3-substituted Pyridyl Compounds are useful for treating or preventing a Condition in an animal in need thereof.

When administered to an animal, the 3-substituted Pyridyl Compounds are administered as a component of a composition that comprises a pharmaceutically acceptable carrier or excipient. The present compositions, which comprise a 3-substituted Pyridyl Compound, can be administered orally. The 3-substituted Pyridyl Compounds of the invention can also be administered by any other convenient route, for example, by infusion or bolus injection, by absorption through epithelial or mucocutaneous linings (*e.g.*, oral, rectal, and intestinal mucosa, *etc.*) and can be administered together with another therapeutically active agent. Administration can be systemic or local. Various delivery systems are known, *e.g.*, encapsulation in liposomes, microparticles, microcapsules, or capsules and can be used to administer the 3-substituted Pyridyl Compound.

Methods of administration include, but are not limited to, intradermal, intramuscular, intraperitoneal, intravenous, subcutaneous, intranasal, epidural, oral, sublingual, intracerebral, intravaginal, transdermal, rectal, by inhalation, or topical,

particularly to the ears, nose, eyes, or skin. The mode of administration is left to the discretion of the practitioner. In most instances, administration will result in the release of the 3-substituted Pyridyl Compounds into the bloodstream.

In specific embodiments, it can be desirable to administer the 3-substituted Pyridyl Compounds locally. This can be achieved, for example, and not by way of limitation, by local infusion during surgery, topical application, *e.g.*, in conjunction with a wound dressing after surgery, by injection, by means of a catheter, by means of a suppository or enema, or by means of an implant, said implant being of a porous, non-porous, or gelatinous material, including membranes, such as sialastic membranes, or fibers.

In certain embodiments, it can be desirable to introduce the 3-substituted Pyridyl Compounds into the central nervous system or gastrointestinal tract by any suitable route, including intraventricular, intrathecal, and epidural injection, and enema. Intraventricular injection can be facilitated by an intraventricular catheter, for example, attached to a reservoir, such as an Ommaya reservoir.

Pulmonary administration can also be employed, *e.g.*, by use of an inhaler or nebulizer, and formulation with an aerosolizing agent, or via perfusion in a fluorocarbon or synthetic pulmonary surfactant. In certain embodiments, the 3-substituted Pyridyl Compounds can be formulated as a suppository, with traditional binders and excipients such as triglycerides.

In another embodiment, the 3-substituted Pyridyl Compounds can be delivered in a vesicle, in particular a liposome (*see* Langer, *Science* 249:1527-1533 (1990) and Treat *et al.*, *Liposomes in the Therapy of Infectious Disease and Cancer* 317-327 and 353-365 (1989)).

In yet another embodiment, the 3-substituted Pyridyl Compounds can be delivered in a controlled-release system or sustained-release system (*see, e.g.*, Goodson, in Medical Applications of Controlled Release, *supra*, vol. 2, pp. 115-138 (1984)). Other controlled- or sustained-release systems discussed in the review by Langer, *Science* 249:1527-1533 (1990) can be used. In one embodiment, a pump can be used (Langer, *Science* 249:1527-1533 (1990); Sefton, *CRC Crit. Ref. Biomed. Eng.* 14:201 (1987); Buchwald *et al.*, *Surgery* 88:507 (1980); and Saudek *et al.*, *N. Engl. J. Med.* 321:574 (1989)). In another embodiment, polymeric materials can be used (*see Medical*

Applications of Controlled Release (Langer and Wise eds., 1974); *Controlled Drug Bioavailability, Drug Product Design and Performance* (Smolen and Ball eds., 1984); Ranger and Peppas, *J. Macromol. Sci. Rev. Macromol. Chem.* 23:61 (1983); Levy *et al.*, *Science* 228:190 (1985); During *et al.*, *Ann. Neurol.* 25:351 (1989); and Howard *et al.*, *J. Neurosurg.* 71:105 (1989)). In yet another embodiment, a controlled- or sustained-release system can be placed in proximity of a target of the 3-substituted Pyridyl Compounds, *e.g.*, the spinal column, brain, or gastrointestinal tract, thus requiring only a fraction of the systemic dose.

The present compositions can optionally comprise a suitable amount of a pharmaceutically acceptable excipient so as to provide the form for proper administration to the animal.

Such pharmaceutical excipients can be liquids, such as water and oils, including those of petroleum, animal, vegetable, or synthetic origin, such as peanut oil, soybean oil, mineral oil, sesame oil and the like. The pharmaceutical excipients can be saline, gum acacia, gelatin, starch paste, talc, keratin, colloidal silica, urea and the like. In addition, auxiliary, stabilizing, thickening, lubricating, and coloring agents can be used. In one embodiment, the pharmaceutically acceptable excipients are sterile when administered to an animal. Water is a particularly useful excipient when the 3-substituted Pyridyl Compound is administered intravenously. Saline solutions and aqueous dextrose and glycerol solutions can also be employed as liquid excipients, particularly for injectable solutions. Suitable pharmaceutical excipients also include starch, glucose, lactose, sucrose, gelatin, malt, rice, flour, chalk, silica gel, sodium stearate, glycerol monostearate, talc, sodium chloride, dried skim milk, glycerol, propylene, glycol, water, ethanol and the like. The present compositions, if desired, can also contain minor amounts of wetting or emulsifying agents, or pH buffering agents.

The present compositions can take the form of solutions, suspensions, emulsion, tablets, pills, pellets, capsules, capsules containing liquids, powders, sustained-release formulations, suppositories, emulsions, aerosols, sprays, suspensions, or any other form suitable for use. In one embodiment, the composition is in the form of a capsule (see *e.g.*, U.S. Patent No. 5,698,155). Other examples of suitable pharmaceutical excipients are described in *Remington's Pharmaceutical Sciences* 1447-1676 (Alfonso R. Gennaro ed., 19th ed. 1995),

In one embodiment, the 3-substituted Pyridyl Compounds are formulated in accordance with routine procedures as a composition adapted for oral administration to human beings. Compositions for oral delivery can be in the form of tablets, lozenges, aqueous or oily suspensions, granules, powders, emulsions, capsules, syrups, or elixirs, for example. Orally administered compositions can contain one or more agents, for example, sweetening agents such as fructose, aspartame or saccharin; flavoring agents such as peppermint, oil of wintergreen, or cherry; coloring agents; and preserving agents, to provide a pharmaceutically palatable preparation. Moreover, where in tablet or pill form, the compositions can be coated to delay disintegration and absorption in the gastrointestinal tract thereby providing a sustained action over an extended period of time. Selectively permeable membranes surrounding an osmotically active driving compound are also suitable for orally administered compositions. In these latter platforms, fluid from the environment surrounding the capsule is imbibed by the driving compound, which swells to displace the agent or agent composition through an aperture. These delivery platforms can provide an essentially zero order delivery profile as opposed to the spiked profiles of immediate release formulations. A time-delay material such as glycerol monostearate or glycerol stearate can also be used. Oral compositions can include standard excipients such as mannitol, lactose, starch, magnesium stearate, sodium saccharin, cellulose, and magnesium carbonate. In one embodiment, the excipients are of pharmaceutical grade.

In another embodiment, the 3-substituted Pyridyl Compounds can be formulated for intravenous administration. Typically, compositions for intravenous administration comprise sterile isotonic aqueous buffer. Where necessary, the compositions can also include a solubilizing agent. Compositions for intravenous administration can optionally include a local anesthetic such as lidocaine to lessen pain at the site of the injection. Generally, the ingredients are supplied either separately or mixed together in unit dosage form, for example, as a dry lyophilized powder or water free concentrate in a hermetically sealed container such as an ampule or sachette indicating the quantity of active agent. Where the 3-substituted Pyridyl Compounds are to be administered by infusion, they can be dispensed, for example, with an infusion bottle containing sterile pharmaceutical grade water or saline. Where the 3-substituted Pyridyl Compounds are administered by injection, an ampule of sterile water for injection or saline can be provided so that the ingredients can be mixed prior to administration.

The 3-substituted Pyridyl Compounds can be administered by controlled-release or sustained-release means or by delivery devices that are known to those of ordinary skill in the art. Examples include, but are not limited to, those described in U.S. Patent Nos.: 3,845,770; 3,916,899; 3,536,809; 3,598,123; 4,008,719; 5,674,533; 5,059,595; 5,591,767; 5,120,548; 5,073,543; 5,639,476; 5,354,556; and 5,733,566.

Such dosage forms can be used to provide controlled- or sustained-release of one or more active ingredients using, for example, hydropropylmethyl cellulose, other polymer matrices, gels, permeable membranes, osmotic systems, multilayer coatings, microparticles, liposomes, microspheres, or a combination thereof to provide the desired release profile in varying proportions. Suitable controlled- or sustained-release formulations known to those of ordinary skill in the art, including those described herein, can be readily selected for use with the active ingredients of the invention. The invention thus encompasses single unit dosage forms suitable for oral administration such as, but not limited to, tablets, capsules, gelcaps, and caplets that are adapted for controlled- or sustained-release.

Controlled- or sustained-release pharmaceutical compositions can have a common goal of improving drug therapy over that achieved by their non-controlled or non-sustained counterparts. In one embodiment, a controlled- or sustained-release composition comprises a minimal amount of a 3-substituted Pyridyl Compound to cure or control the condition in a minimum amount of time. Advantages of controlled- or sustained-release compositions include extended activity of the drug, reduced dosage frequency, and increased patient compliance. In addition, controlled- or sustained-release compositions can favorably affect the time of onset of action or other characteristics, such as blood levels of the 3-substituted Pyridyl Compound, and can thus reduce the occurrence of adverse side effects.

Controlled- or sustained-release compositions can initially release an amount of a 3-substituted Pyridyl Compound that promptly produces the desired therapeutic or prophylactic effect, and gradually and continually release other amounts of the 3-substituted Pyridyl Compound to maintain this level of therapeutic or prophylactic effect over an extended period of time. To maintain a constant level of the 3-substituted Pyridyl Compound in the body, the 3-substituted Pyridyl Compound can be released from the dosage form at a rate that will replace the amount of 3-substituted Pyridyl Compound being metabolized and excreted from the body. Controlled- or sustained-

release of an active ingredient can be stimulated by various conditions, including but not limited to, changes in pH, changes in temperature, concentration or availability of enzymes, concentration or availability of water, or other physiological conditions or compounds.

The amount of the 3-substituted Pyridyl Compound that is effective in the treatment or prevention of a condition can be determined by standard clinical techniques. In addition, *in vitro* or *in vivo* assays can optionally be employed to help identify optimal dosage ranges. The precise dose to be employed will also depend on the route of administration, and the seriousness of the Condition and can be decided according to the judgment of a practitioner and and/or each animal's circumstances. Suitable effective dosage amounts, however, range from about 0.01 mg/kg of body weight to about 2500 mg/kg of body weight, although they are typically about 100 mg/kg of body weight or less. In one embodiment, the effective dosage amount ranges from about 0.01 mg/kg of body weight to about 100 mg/kg of body weight of a 3-substituted Pyridyl Compound, in another embodiment, about 0.02 mg/kg of body weight to about 50 mg/kg of body weight, and in another embodiment, about 0.025 mg/kg of body weight to about 20 mg/kg of body weight. In one embodiment, an effective dosage amount is administered about every 24 h until the Condition is abated. In another embodiment, an effective dosage amount is administered about every 12 h until the Condition is abated. In another embodiment, an effective dosage amount is administered about every 8 h until the Condition is abated. In another embodiment, an effective dosage amount is administered about every 6 h until the Condition is abated. In another embodiment, an effective dosage amount is administered about every 4 h until the Condition is abated. The effective dosage amounts described herein refer to total amounts administered; that is, if more than one 3-substituted Pyridyl Compound is administered, the effective dosage amounts correspond to the total amount administered.

Where a cell capable of expressing VR1, mGluR5 or mGluR1 is contacted with a 3-substituted Pyridyl Compound *in vitro*, the amount effective for inhibiting the VR1, mGluR5 or mGluR1 receptor function in a cell will typically range from about 0.01 μg/L to about 5 mg/L, in one embodiment, from about 0.01 μg/L to about 2.5 mg/L, in another embodiment, from about 0.01 μg/L to about 0.5 mg/L, and in another embodiment, from about 0.01 μg/L to about 0.25 mg/L of a solution or suspension of a pharmaceutically acceptable carrier or excipient. In one embodiment, the volume of solution or

suspension comprising the 3-substituted Pyridyl Compound is from about 0.01 μL to about 1 mL. In another embodiment, the volume of solution or suspension is about 200 μL.

Where a cell capable of expressing VR1, mGluR5, or mGluR1 is contacted with a 3-substituted Pyridyl Compound *in vivo*, the amount effective for inhibiting the receptor function in a cell will typically range from about 0.01 mg/kg of body weight to about 2500 mg/kg of body weight, although it typically ranges from about 100 mg/kg of body weight or less. In one embodiment, the effective dosage amount ranges from about 0.01 mg/kg of body weight to about 100 mg/kg of body weight of a 3-substituted Pyridyl Compound, in another embodiment, about 0.020 mg/kg of body weight to about 50 mg/kg of body weight, and in another embodiment, about 0.025 mg/kg of body weight to about 20 mg/kg of body weight. In one embodiment, an effective dosage amount is administered about every 24 h. In another embodiment, an effective dosage amount is administered about every 12 h. In another embodiment, an effective dosage amount is administered about every 8 h. In another embodiment, an effective dosage amount is administered about every 6 h. In another embodiment, an effective dosage amount is administered about every 4 h.

The 3-substituted Pyridyl Compounds can be assayed *in vitro* or *in vivo* for the desired therapeutic or prophylactic activity prior to use in humans. Animal model systems can be used to demonstrate safety and efficacy.

The present methods for treating or preventing a Condition in an animal in need thereof can further comprise administering to the animal being administered a 3-substituted Pyridyl Compound another therapeutic agent. In one embodiment, the other therapeutic agent is administered in an effective amount.

The present methods for inhibiting VR1 function in a cell capable of expressing VR1 can further comprise contacting the cell with an effective amount of another therapeutic agent.

The present methods for inhibiting mGluR5 function in a cell capable of expressing mGluR5 can further comprise contacting the cell with an effective amount of another therapeutic agent.

The present methods for inhibiting mGluR1 function in a cell capable of expressing mGluR1 can further comprise contacting the cell with an effective amount of another therapeutic agent.

Effective amounts of the other therapeutic agents are known to those skilled in the art. However, it is within the skilled artisan's purview to determine the other therapeutic agent's optimal effective-amount range. In one embodiment of the invention, where another therapeutic agent is administered to an animal, the effective amount of the 3-substituted Pyridyl Compound is less than its effective amount would be where the other therapeutic agent is not administered. In this case, without being bound by theory, it is believed that the 3-substituted Pyridyl Compound s and the other therapeutic agent act synergistically to treat or prevent a Condition.

The other therapeutic agent can be, but is not limited to, an opioid agonist, a non-opioid analgesic, a non-steroidal anti-inflammatory agent, an antimigraine agent, a Cox-II inhibitor, an antiemetic, a β-adrenergic blocker, an anticonvulsant, an antidepressant, a Ca2+-channel blocker, an anticancer agent, an agent for treating or preventing UI, an agent for treating or preventing an ulcer, an agent for treating or preventing IBD, an agent for treating or preventing IBS, an agent for treating addictive disorder, an agent for treating Parkinson's disease and parkinsonism, an agent for treating anxiety, an agent for treating epilepsy, an agent for treating a stroke, an agent for treating a seizure, an agent for treating a pruritic condition, an agent for treating psychosis, an agent for treating Huntington's chorea, an agent for treating ALS, an agent for treating a cognitive disorder, an agent for treating a migraine, an agent for treating vomiting, an agent for treating dyskinesia, or an agent for treating depression, and mixtures thereof.

Examples of useful opioid agonists include, but are not limited to, alfentanil, allylprodine, alphaprodine, anileridine, benzylmorphine, bezitramide, buprenorphine, butorphanol, clonitazene, codeine, desomorphine, dextromoramide, dezocine, diampromide, diamorphone, dihydrocodeine, dihydromorphine, dimenoxadol, dimepheptanol, dimethylthiambutene, dioxaphetyl butyrate, dipipanone, eptazocine, ethoheptazine, ethylmethylthiambutene, ethylmorphine, etonitazene fentanyl, heroin, hydrocodone, hydromorphone, hydroxypethidine, isomethadone, ketobemidone, levorphanol, levophenacylmorphan, lofentanil, meperidine, meptazinol, metazocine, methadone, metopon, morphine, myrophine, nalbuphine, narceine, nicomorphine, norlevorphanol, normethadone, nalorphine, normorphine, norpipanone, opium,

oxycodone, oxymorphone, papaveretum, pentazocine, phenadoxone, phenomorphan, phenazocine, phenoperidine, piminodine, piritramide, proheptazine, promedol, properidine, propiram, propoxyphene, sufentanil, tilidine, tramadol, pharmaceutically acceptable salts thereof, and mixtures thereof.

In certain embodiments, the opioid agonist is selected from codeine, hydromorphone, hydrocodone, oxycodone, dihydrocodeine, dihydromorphine, morphine, tramadol, oxymorphone, pharmaceutically acceptable salts thereof, and mixtures thereof.

Examples of useful non-opioid analgesics include non-steroidal anti-inflammatory agents, such as aspirin, ibuprofen, diclofenac, naproxen, benoxaprofen, flurbiprofen, fenoprofen, flubufen, ketoprofen, indoprofen, piroprofen, carprofen, oxaprozin, pramoprofen, muroprofen, trioxaprofen, suprofen, aminoprofen, tiaprofenic acid, fluprofen, bucloxic acid, indomethacin, sulindac, tolmetin, zomepirac, tiopinac, zidometacin, acemetacin, fentiazac, clidanac, oxpinac, mefenamic acid, meclofenamic acid, flufenamic acid, niflumic acid, tolfenamic acid, diflurisal, flufenisal, piroxicam, sudoxicam, isoxicam, and pharmaceutically acceptable salts thereof, and mixtures thereof. Other suitable non-opioid analgesics include the following, non-limiting, chemical classes of analgesic, antipyretic, nonsteroidal anti-inflammatory drugs: salicylic acid derivatives, including aspirin, sodium salicylate, choline magnesium trisalicylate, salsalate, diflunisal, salicylsalicylic acid, sulfasalazine, and olsalazin; para-aminophenol derivatives including acetaminophen and phenacetin; indole and indene acetic acids, including indomethacin, sulindac, and etodolac; heteroaryl acetic acids, including tolmetin, diclofenac, and ketorolac; anthranilic acids (fenamates), including mefenamic acid and meclofenamic acid; enolic acids, including oxicams (piroxicam, tenoxicam), and pyrazolidinediones (phenylbutazone, oxyphenthartazone); and alkanones, including nabumetone. For a more detailed description of the NSAIDs, *see Paul A. Insel, Analgesic-Antipyretic and Anti-inflammatory Agents and Drugs Employed in the Treatment of Gout, in Goodman & Gilman's The Pharmacological Basis of Therapeutics* 617-57 (Perry B. Molinhoff and Raymond W. Ruddon eds., 9th ed 1996) and Glen R. Hanson, *Analgesic, Antipyretic and Anti-Inflammatory Drugs in Remington: The Science and Practice of Pharmacy Vol II* 1196-1221 (A.R. Gennaro ed. 19th ed. 1995) v

Examples of useful Cox-II inhibitors and 5-lipoxygenase inhibitors, as well as combinations thereof, are described in U.S. Patent No. 6,136,839,

Examples of useful Cox-II inhibitors include, but are not limited to, rofecoxib and celecoxib.

Examples of useful antimigraine agents include, but are not limited to, alpiropride, bromocriptine, dihydroergotamine, dolasetron, ergocornine, ergocorninine, ergocryptine, ergonovine, ergot, ergotamine, flumedroxone acetate, fonazine, ketanserin, lisuride, lomerizine, methylergonovine, methysergide, metoprolol, naratriptan, oxetorone, pizotyline, propranolol, risperidone, rizatriptan, sumatriptan, timolol, trazodone, zolmitriptan, and mixtures thereof.

The other therapeutic agent can also be an agent useful for reducing any potential side effect of a 3-substituted Pyridyl Compounds. For example, the other therapeutic agent can be an antiemetic agent. Examples of useful antiemetic agents include, but are not limited to, metoclopromide, domperidone, prochlorperazine, promethazine, chlorpromazine, trimethobenzamide, odansteron, granisetron, hydroxyzine, acetylleucine monoethanolamine, alizapride, azasetron, benzquinamide, bietanautine, bromopride, buclizine, clebopride, cyclizine, dimenhydrinate, diphenidol, dolasetron, meclizine, methallatal, metopimazine, nabilone, oxyperndyl, pipamazine, scopolamine, sulpiride, tetrahydrocannabinol, thiethylperazine, thioproperazine, tropisetron, and mixtures thereof.

Examples of useful β-adrenergic blockers include, but are not limited to, acebutolol, alprenolol, amosulabol, arotinolol, atenolol, befunolol, betaxolol, bevantolol, bisoprolol, bopindolol, bucumolol, bufetolol, bufuralol, bunitrolol, bupranolol, butidrine hydrochloride, butofilolol, carazolol, carteolol, carvedilol, celiprolol, cetamolol, cloranolol, dilevalol, epanolol, esmolol, indenolol, labetalol, levobunolol, mepindolol, metipranolol, metoprolol, moprolol, nadolol, nadoxolol, nebivalol, nifenalol, nipradilol, oxprenolol, penbutolol, pindolol, practolol, pronethalol, propranolol, sotalol, sulfinalol, talinolol, tertatolol, tilisolol, timolol, toliprolol, and xibenolol.

Examples of useful anticonvulsants include, but are not limited to, acetylpheneturide, albutoin, aloxidone, aminoglutethimide, 4-amino-3-hydroxybutyric acid, atrolactamide, beclamide, buramate, calcium bromide, carbamazepine, cinromide, clomethiazole, clonazepam, decimemide, diethadione, dimethadione, doxenitroin,

eterobarb, ethadione, ethosuximide, ethotoin, felbamate, fluoresone, gabapentin, 5-hydroxytryptophan, lamotrigine, magnesium bromide, magnesium sulfate, mephenytoin, mephobarbital, metharbital, methetoin, methsuximide, 5-methyl-5-(3-phenanthryl)-hydantoin, 3-methyl-5-phenylhydantoin, narcobarbital, nimetazepam, nitrazepam, oxcarbazepine, paramethadione, phenacemide, phenetharbital, pheneturide, phenobarbital, phensuximide, phenylmethylbarbituric acid, phenytoin, phethenylate sodium, potassium bromide, pregabaline, primidone, progabide, sodium bromide, solanum, strontium bromide, suclofenide, sulthiame, tetrantoin, tiagabine, topiramate, trimethadione, valproic acid, valpromide, vigabatrin, and zonisamide.

Examples of useful antidepressants include, but are not limited to, binedaline, caroxazone, citalopram, (S)-citalopram, dimethazan, fencamine, indalpine, indeloxazine hydrocholoride, nefopam, nomifensine, oxitriptan, oxypertine, paroxetine, sertraline, thiazesim, trazodone, benmoxine, iproclozide, iproniazid, isocarboxazid, nialamide, octamoxin, phenelzine, cotinine, rolicyprine, rolipram, maprotiline, metralindole, mianserin, mirtazepine, adinazolam, amitriptyline, amitriptylinoxide, amoxapine, butriptyline, clomipramine, demexiptiline, desipramine, dibenzepin, dimetacrine, dothiepin, doxepin, fluacizine, imipramine, imipramine N-oxide, iprindole, lofepramine, melitracen, metapramine, nortriptyline, noxiptilin, opipramol, pizotyline, propizepine, protriptyline, quinupramine, tianeptine, trimipramine, adrafinil, benactyzine, bupropion, butacetin, dioxadrol, duloxetine, etoperidone, febarbamate, femoxetine, fenpentadiol, fluoxetine, fluvoxamine, hematoporphyrin, hypericin, levophacetoperane, medifoxamine, milnacipran, minaprine, moclobemide, nefazodone, oxaflozane, piberaline, prolintane, pyrisuccideanol, ritanserin, roxindole, rubidium chloride, sulpiride, tandospirone, thozalinone, tofenacin, toloxatone, tranylcypromine, L-tryptophan, venlafaxine, viloxazine, and zimelidine.

Examples of useful Ca2+-channel blockers include, but are not limited to, bepridil, clentiazem, diltiazem, fendiline, gallopamil, mibefradil, prenylamine, semotiadil, terodiline, verapamil, amlodipine, aranidipine, barnidipine, benidipine, cilnidipine, efonidipine, elgodipine, felodipine, isradipine, lacidipine, lercanidipine, manidipine, nicardipine, nifedipine, nilvadipine, nimodipine, nisoldipine, nitrendipine, cinnarizine, flunarizine, lidoflazine, lomerizine, bencyclane, etafenone, fantofarone, and perhexiline.

Examples of useful anticancer agents include, but are not limited to, acivicin, aclarubicin, acodazole hydrochloride, acronine, adozelesin, aldesleukin, altretamine, ambomycin, ametantrone acetate, aminoglutethimide, amsacrine, anastrozole, anthramycin, asparaginase, asperlin, azacitidine, azetepa, azotomycin, batimastat, benzodepa, bicalutamide, bisantrene hydrochloride, bisnafide dimesylate, bizelesin, bleomycin sulfate, brequinar sodium, bropirimine, busulfan, cactinomycin, calusterone, caracemide, carbetimer, carboplatin, carmustine, carubicin hydrochloride, carzelesin, cedefingol, chlorambucil, cirolemycin, cisplatin, cladribine, crisnatol mesylate, cyclophosphamide, cytarabine, dacarbazine, dactinomycin, daunorubicin hydrochloride, decitabine, dexormaplatin, dezaguanine, dezaguanine mesylate, diaziquone, docetaxel, doxorubicin, doxorubicin hydrochloride, droloxifene, droloxifene citrate, dromostanolone propionate, duazomycin, edatrexate, eflornithine hydrochloride, elsamitrucin, enloplatin, enpromate, epipropidine, epirubicin hydrochloride, erbulozole, esorubicin hydrochloride, estramustine, estramustine phosphate sodium, etanidazole, etoposide, etoposide phosphate, etoprine, fadrozole hydrochloride, fazarabine, fenretinide, floxuridine, fludarabine phosphate, fluorouracil, flurocitabine, fosquidone, fostriecin sodium, gemcitabine, gemcitabine hydrochloride, hydroxyurea, idarubicin hydrochloride, ifosfamide, ilmofosine, interleukin II (including recombinant interleukin II or rIL2), interferon alpha-2a, interferon alpha-2b, interferon alpha-n1, interferon alpha-n3, interferon beta-I a, interferon gamma-I b, iproplatin, irinotecan hydrochloride, lanreotide acetate, letrozole, leuprolide acetate, liarozole hydrochloride, lometrexol sodium, lomustine, losoxantrone hydrochloride, masoprocol, maytansine, mechlorethamine hydrochloride, megestrol acetate, melengestrol acetate, melphalan, menogaril, mercaptopurine, methotrexate, methotrexate sodium, metoprine, meturedepa, mitindomide, mitocarcin, mitocromin, mitogillin, mitomalcin, mitomycin, mitosper, mitotane, mitoxantrone hydrochloride, mycophenolic acid, nocodazole, nogalamycin, ormaplatin, oxisuran, paclitaxel, pegaspargase, peliomycin, pentamustine, peplomycin sulfate, perfosfamide, pipobroman, piposulfan, piroxantrone hydrochloride, plicamycin, plomestane, porfimer sodium, porfiromycin, prednimustine, procarbazine hydrochloride, puromycin, puromycin hydrochloride, pyrazofurin, riboprine, rogletimide, safingol, safingol hydrochloride, semustine, simtrazene, sparfosate sodium, sparsomycin, spirogermanium hydrochloride, spiromustine, spiroplatin, streptonigrin, streptozotocin, sulofenur, talisomycin, tecogalan sodium, tegafur, teloxantrone hydrochloride, temoporfin, teniposide, teroxirone, testolactone, thiamiprine, thioguanine, thiotepa,

tiazofurin, tirapazamine, toremifene citrate, trestolone acetate, triciribine phosphate, trimetrexate, trimetrexate glucuronate, triptorelin, tubulozole hydrochloride, uracil mustard, uredepa, vapreotide, verteporfin, vinblastine sulfate, vincristine sulfate, vindesine, vindesine sulfate, vinepidine sulfate, vinglycinate sulfate, vinleurosine sulfate, vinorelbine tartrate, vinrosidine sulfate, vinzolidine sulfate, vorozole, zeniplatin, zinostatin, zorubicin hydrochloride.

Examples of other anti-cancer drugs include, but are not limited to, 20-epi-1,25 dihydroxyvitamin D3; 5-ethynyluracil; abiraterone; aclarubicin; acylfulvene; adecypenol; adozelesin; aldesleukin; ALL-TK antagonists; altretamine; ambamustine; amidox; amifostine; aminolevulinic acid; amrubicin; amsacrine; anagrelide; anastrozole; andrographolide; angiogenesis inhibitors; antagonist D; antagonist G; antarelix; anti-dorsalizing morphogenetic protein-1; antiandrogen, prostatic carcinoma; antiestrogen; antineoplaston; antisense oligonucleotides; aphidicolin glycinate; apoptosis gene modulators; apoptosis regulators; apurinic acid; ara-CDP-DL-PTBA; arginine deaminase; asulacrine; atamestane; atrimustine; axinastatin 1; axinastatin 2; axinastatin 3; azasetron; azatoxin; azatyrosine; baccatin III derivatives; balanol; batimastat; BCR/ABL antagonists; benzochlorins; benzoylstaurosporine; beta lactam derivatives; beta-alethine; betaclamycin B; betulinic acid; bFGF inhibitor; bicalutamide; bisantrene; bisaziridinylspermine; bisnafide; bistratene A; bizelesin; breflate; bropirimine; budotitane; buthionine sulfoximine; calcipotriol; calphostin C; camptothecin derivatives; canarypox IL-2; capecitabine; carboxamide-amino-triazole; carboxyamidotriazole; CaRest M3; CARN 700; cartilage derived inhibitor; carzelesin; casein kinase inhibitors (ICOS); castanospermine; cecropin B; cetrorelix; chlorlns; chloroquinoxaline sulfonamide; cicaprost; cis-porphyrin; cladribine; clomifene analogues; clotrimazole; collismycin A; collismycin B; combretastatin A4; combretastatin analogue; conagenin; crambescidin 816; crisnatol; cryptophycin 8; cryptophycin A derivatives; curacin A; cyclopentanthraquinones; cycloplatam; cypemycin; cytarabine ocfosfate; cytolytic factor; cytostatin; dacliximab; decitabine; dehydrodidemnin B; deslorelin; dexamethasone; dexifosfamide; dexrazoxane; dexverapamil; diaziquone; didemnin B; didox; diethylnorspermine; dihydro-5-azacytidine; 9-dihydrotaxol; dioxamycin; diphenyl spiromustine; docetaxel; docosanol; dolasetron; doxifluridine; droloxifene; dronabinol; duocarmycin SA; ebselen; ecomustine; edelfosine; edrecolomab; eflornithine; elemene; emitefur; epirubicin; epristeride; estramustine analogue; estrogen agonists; estrogen

antagonists; etanidazole; etoposide phosphate; exemestane; fadrozole; fazarabine; fenretinide; filgrastim; finasteride; flavopiridol; flezelastine; fluasterone; fludarabine; fluorodaunorunicin hydrochloride; forfenimex; formestane; fostriecin; fotemustine; gadolinium texaphyrin; gallium nitrate; galocitabine; ganirelix; gelatinase inhibitors; gemcitabine; glutathione inhibitors; hepsulfam; heregulin; hexamethylene bisacetamide; hypericin; ibandronic acid; idarubicin; idoxifene; idramantone; ilmofosine; ilomastat; imidazoacridones; imiquimod; immunostimulant peptides; insulin-like growth factor-1 receptor inhibitor; interferon agonists; interferons; interleukins; iobenguane; iododoxorubicin; 4-ipomeanol; iroplact; irsogladine; isobengazole; isohomohalicondrin B; itasetron; jasplakinolide; kahalalide F; lamellarin-N triacetate; lanreotide; leinamycin; lenograstim; lentinan sulfate; leptolstatin; letrozole; leukemia inhibiting factor; leukocyte alpha interferon; leuprolide+estrogen+progesterone; leuprorelin; levamisole; liarozole; linear polyamine analogue; lipophilic disaccharide peptide; lipophilic platinum compounds; lissoclinamide 7; lobaplatin; lombricine; lometrexol; lonidamine; losoxantrone; lovastatin; loxoribine; lurtotecan; lutetium texaphyrin; lysofylline; lytic peptides; maitansine; mannostatin A; marimastat; masoprocol; maspin; matrilysin inhibitors; matrix metalloproteinase inhibitors; menogaril; merbarone; meterelin; methioninase; metoclopramide; MIF inhibitor; mifepristone; miltefosine; mirimostim; mismatched double stranded RNA; mitoguazone; mitolactol; mitomycin analogues; mitonafide; mitotoxin fibroblast growth factor-saporin; mitoxantrone; mofarotene; molgramostim; monoclonal antibody, human chorionic gonadotrophin; monophosphoryl lipid A+myobacterium cell wall sk; mopidamol; multiple drug resistance gene inhibitor; multiple tumor suppressor 1-based therapy; mustard anticancer agent; mycaperoxide B; mycobacterial cell wall extract; myriaporone; N-acetyldinaline; N-substituted benzamides; nafarelin; nagrestip; naloxone+pentazocine; napavin; naphterpin; nartograstim; nedaplatin; nemorubicin; neridronic acid; neutral endopeptidase; nilutamide; nisamycin; nitric oxide modulators; nitroxide antioxidant; nitrullyn; O6-benzylguanine; octreotide; okicenone; oligonucleotides; onapristone; odansteron; oracin; oral cytokine inducer; ormaplatin; osaterone; oxaliplatin; oxaunomycin; paclitaxel; paclitaxel analogues; paclitaxel derivatives; palauamine; palmitoylrhizoxin; pamidronic acid; panaxytriol; panomifene; parabactin; pazelliptine; pegaspargase; peldesine; pentosan polysulfate sodium; pentostatin; pentrozole; perflubron; perfosfamide; perillyl alcohol; phenazinomycin; phenylacetate; phosphatase inhibitors; picibanil; pilocarpine hydrochloride; pirarubicin; piritrexim; placetin A; placetin B;

plasminogen activator inhibitor; platinum complex; platinum compounds; platinum-triamine complex; porfimer sodium; porfiromycin; prednisone; propyl bis-acridone; prostaglandin J2; proteasome inhibitors; protein A-based immune modulator; protein kinase C inhibitor; protein kinase C inhibitors, microalgal; protein tyrosine phosphatase inhibitors; purine nucleoside phosphorylase inhibitors; purpurins; pyrazoloacridine; pyridoxylated hemoglobin polyoxyethylene conjugate; raf antagonists; raltitrexed; ramosetron; ras farnesyl protein transferase inhibitors; ras inhibitors; ras-GAP inhibitor; retelliptine demethylated; rhenium Re 186 etidronate; rhizoxin; ribozymes; RII retinamide; rogletimide; rohitukine; romurtide; roquinimex; rubiginone B1; ruboxyl; safingol; saintopin; SarCNU; sarcophytol A; sargramostim; Sdi 1 mimetics; semustine; senescence derived inhibitor 1; sense oligonucleotides; signal transduction inhibitors; signal transduction modulators; single chain antigen binding protein; sizofiran; sobuzoxane; sodium borocaptate; sodium phenylacetate; solverol; somatomedin binding protein; sonermin; sparfosic acid; spicamycin D; spiromustine; splenopentin; spongistatin 1; squalamine; stem cell inhibitor; stem-cell division inhibitors; stipiamide; stromelysin inhibitors; sulfinosine; superactive vasoactive intestinal peptide antagonist; suradista; suramin; swainsonine; synthetic glycosaminoglycans; tallimustine; tamoxifen methiodide; tauromustine; tazarotene; tecogalan sodium; tegafur; tellurapyrylium; telomerase inhibitors; temoporfin; temozolomide; teniposide; tetrachlorodecaoxide; tetrazomine; thaliblastine; thiocoraline; thrombopoietin; thrombopoietin mimetic; thymalfasin; thymopoietin receptor agonist; thymotrinan; thyroid stimulating hormone; tin ethyl etiopurpurin; tirapazamine; titanocene bichloride; topsentin; toremifene; totipotent stem cell factor; translation inhibitors; tretinoin; triacetyluridine; triciribine; trimetrexate; triptorelin; tropisetron; turosteride; tyrosine kinase inhibitors; tyrphostins; UBC inhibitors; ubenimex; urogenital sinus-derived growth inhibitory factor; urokinase receptor antagonists; vapreotide; variolin B; vector system, erythrocyte gene therapy; velaresol; veramine; verdins; verteporfin; vinorelbine; vinxaltine; vitaxin; vorozole; zanoterone; zeniplatin; zilascorb; and zinostatin stimalamer.

Examples of useful therapeutic agents for treating or preventing UI include, but are not limited to, propantheline, imipramine, hyoscyamine, oxybutynin, and dicyclomine.

Examples of useful therapeutic agents for treating or preventing an ulcer include, antacids such as aluminum hydroxide, magnesium hydroxide, sodium bicarbonate, and calcium bicarbonate; sucraflate; bismuth compounds such as bismuth subsalicylate and bismuth subcitrate; H_2 antagonists such as cimetidine, ranitidine, famotidine, and nizatidine; H^+, K^+ - ATPase inhibitors such as omeprazole, iansoprazole, and lansoprazole; carbenoxolone; misprostol; and antibiotics such as tetracycline, metronidazole, timidazole, clarithromycin, and amoxicillin.

Examples of useful therapeutic agents for treating or preventing IBD include, but are not limited to, anticholinergic drugs; diphenoxylate; loperamide; deodorized opium tincture; codeine; broad-spectrum antibiotics such as metronidazole; sulfasalazine; olsalazine; mesalamine; prednisone; azathioprine; mercaptopurine; and methotrexate.

Examples of useful therapeutic agents for treating or preventing IBS include, but are not limited to, propantheline; muscarine receptor antogonists such as pirenzapine, methoctramine, ipratropium, tiotropium, scopolamine, methscopolamine, homatropine, homatropine methylbromide, and methantheline; and antidiarrheal drugs such as diphenoxylate and loperamide.

Examples of useful therapeutic agents for treating or preventing an addictive disorder include, but are not limited to, methadone, desipramine, amantadine, fluoxetine, buprenorphine, an opiate agonist, 3-phenoxypyridine, levomethadyl acetate hydrochloride, and serotonin antagonists.

Examples of useful therapeutic agents for treating or preventing Parkinson's disease and parkinsonism include, but are not limited to, carbidopa/levodopa, pergolide, bromocriptine, ropinirole, pramipexole, entacapone, tolcapone, selegiline, amantadine, and trihexyphenidyl hydrochloride.

Examples of useful therapeutic agents for treating or preventing anxiety include, but are not limited to, benzodiazepines, such as alprazolam, brotizolam, chlordiazepoxide, clobazam, clonazepam, clorazepate, demoxepam, diazepam, estazolam, flumazenil, flurazepam, halazepam, lorazepam, midazolam, nitrazepam, nordazepam, oxazepam, prazepam, quazepam, temazepam, and triazolam; non-benzodiazepine agents, such as buspirone, gepirone, ipsapirone, tiospirone, zolpicone, zolpidem, and zaleplon; tranquilizers, such as barbituates, *e.g.*, amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, methohexital, pentobarbital, phenobarbital,

secobarbital, and thiopental; and propanediol carbamates, such as meprobamate and tybamate.

Examples of useful therapeutic agents for treating or preventing epilepsy include, but are not limited to, carbamazepine, ethosuximide, gabapentin, lamotrigine, phenobarbital, phenytoin, primidone, valproic acid, trimethadione, benzodiazepines, γ-vinyl GABA, acetazolamide, and felbamate.

Examples of useful therapeutic agents for treating or preventing stroke include, but are not limited to, anticoagulants such as heparin, agents that break up clots such as streptokinase or tissue plasminogen activator, agents that reduce swelling such as mannitol or corticosteroids, and acetylsalicylic acid.

Examples of useful therapeutic agents for treating or preventing a seizure include, but are not limited to, carbamazepine, ethosuximide, gabapentin, lamotrigine, phenobarbital, phenytoin, primidone, valproic acid, trimethadione, benzodiazepines, gabapentin, lamotrigine, γ-vinyl GABA, acetazolamide, and felbamate.

Examples of useful therapeutic agents for treating or preventing a pruritic condition include, but are not limited to, naltrexone; nalmefene; danazol; tricyclics such as amitriptyline, imipramine, and doxepin; antidepressants such as those given below, menthol; camphor; phenol; pramoxine; capsaicin; tar; steroids; and antihistamines.

Examples of useful therapeutic agents for treating or preventing psychosis include, but are not limited to, phenothiazines such as chlorpromazine hydrochloride, mesoridazine besylate, and thoridazine hydrochloride; thioxanthenes such as chloroprothixene and thiothixene hydrochloride; clozapine; risperidone; olanzapine; quetiapine; quetiapine fumarate; haloperidol; haloperidol decanoate; loxapine succinate; molindone hydrochloride; pimozide; and ziprasidone.

Examples of useful therapeutic agents for treating or preventing Huntington's chorea include, but are not limited to, haloperidol and pimozide.

Examples of useful therapeutic agents for treating or preventing ALS include, but are not limited to, baclofen, neurotrophic factors, riluzole, tizanidine, benzodiazepines such as clonazepan and dantrolene.

Examples of useful therapeutic agents for treating or preventing cognitive disorders include, but are not limited to, agents for treating or preventing dementia such

as tacrine; donepezil; ibuprofen; antipsychotic drugs such as thioridazine and haloperidol; and antidepressant drugs such as those given below.

Examples of useful therapeutic agents for treating or preventing a migraine include, but are not limited to, sumatriptan; methysergide; ergotamine; caffeine; and beta-blockers such as propranolol, verapamil, and divalproex.

Examples of useful therapeutic agents for treating, inhibiting, or preventing vomiting include, but are not limited to, 5-HT_3 receptor antagonists such as odansteron, dolasetron, granisetron, and tropisetron; dopamine receptor antagonists such as prochlorperazine, thiethylperazine, chlorpromazin, metoclopramide, and domperidone; glucocorticoids such as dexamethasone; and benzodiazepines such as lorazepam and alprazolam.

Examples of useful therapeutic agents for treating or preventing dyskinesia include, but are not limited to, reserpine and tetrabenazine.

Examples of useful therapeutic agents for treating or preventing depression include, but are not limited to, tricyclic antidepressants such as amitryptyline, amoxapine, bupropion, clomipramine, desipramine, doxepin, imipramine, maprotiline, nefazadone, nortriptyline, protriptyline, trazodone, trimipramine, and venlafaxine; selective serotonin reuptake inhibitors such as citalopram, (S)-citalopram, fluoxetine, fluvoxamine, paroxetine, and setraline; monoamine oxidase inhibitors such as isocarboxazid, pargyline, phenelzine, and tranylcypromine; and psychostimulants such as dextroamphetamine and methylphenidate.

A 3-substituted Pyridyl Compound and the other therapeutic agent can act additively or, in one embodiment, synergistically. In one embodiment, a 3-substituted Pyridyl Compound is administered concurrently with another therapeutic agent; for example, a composition comprising an effective amount of a 3-substituted Pyridyl Compound and an effective amount of another therapeutic agent can be administered. Alternatively, a composition comprising an effective amount of a 3-substituted Pyridyl Compound and a different composition comprising an effective amount of another therapeutic agent can be concurrently administered. In another embodiment, an effective amount of a 3-substituted Pyridyl Compound is administered prior or subsequent to administration of an effective amount of another therapeutic agent. In this embodiment, the 3-substituted Pyridyl Compound is administered while the other therapeutic agent

exerts its therapeutic effect, or the other therapeutic agent is administered while the 3-substituted Pyridyl Compound exerts its therapeutic effect for treating or preventing a Condition.

A composition of the invention is prepared by a method comprising admixing a 3-substituted Pyridyl Compound or a pharmaceutically acceptable salt and a pharmaceutically acceptable carrier or excipient. Admixing can be accomplished using methods known for admixing a compound (or salt) and a pharmaceutically acceptable carrier or excipient. In one embodiment the 3-substituted Pyridyl Compound is present in the composition in an effective amount.

4.6.2 KITS

The invention encompasses kits that can simplify the administration of a 3-substituted Pyridyl Compound to an animal.

A typical kit of the invention comprises a unit dosage form of a 3-substituted Pyridyl Compound. In one embodiment, the unit dosage form is a container, which can be sterile, containing an effective amount of a 3-substituted Pyridyl Compound and a pharmaceutically acceptable carrier or excipient. The kit can further comprise a label or printed instructions instructing the use of the 3-substituted Pyridyl Compound to treat a Condition. The kit can also further comprise a unit dosage form of another therapeutic agent, for example, a second container containing an effective amount of the other therapeutic agent and a pharmaceutically acceptable carrier or excipient. In another embodiment, the kit comprises a container containing an effective amount of a 3-substituted Pyridyl Compound, an effective amount of another therapeutic agent and a pharmaceutically acceptable carrier or excipient. Examples of other therapeutic agents include, but are not limited to, those listed above.

Kits of the invention can further comprise a device that is useful for administering the unit dosage forms. Examples of such a device include, but are not limited to, a syringe, a drip bag, a patch, an inhaler, and an enema bag.

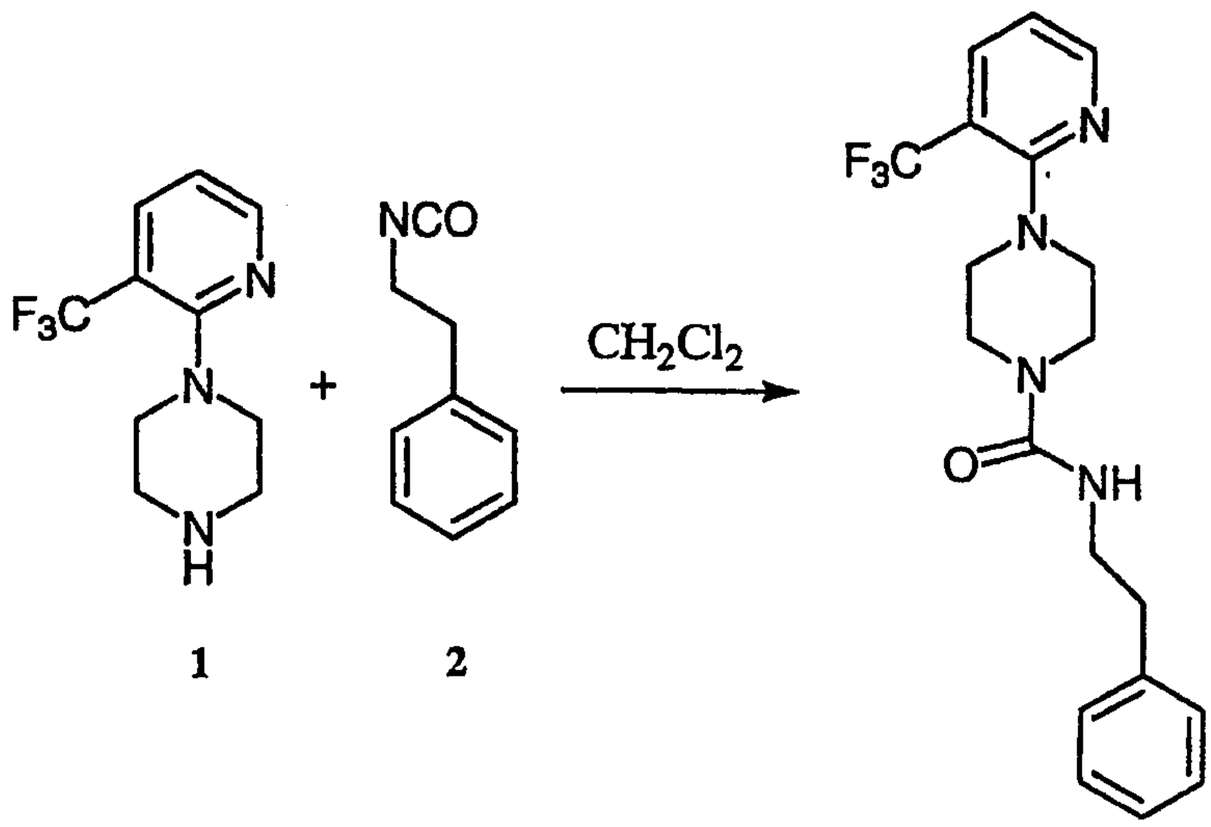
The following examples are set forth to assist in understanding the invention and should not be construed as specifically limiting the invention described and claimed herein. Such variations of the invention, including the substitution of all equivalents now known or later developed, which would be within the purview of those skilled in the art,

and changes in formulation or minor changes in experimental design, are to be considered to fall within the scope of the invention incorporated herein.

5. EXAMPLES

Examples 1-5 relate to the synthesis of illustrative 3-substituted Pyridyl Compounds.

5.1 EXAMPLE 1: SYNTHESIS OF COMPOUND A19



1 2 **A19**

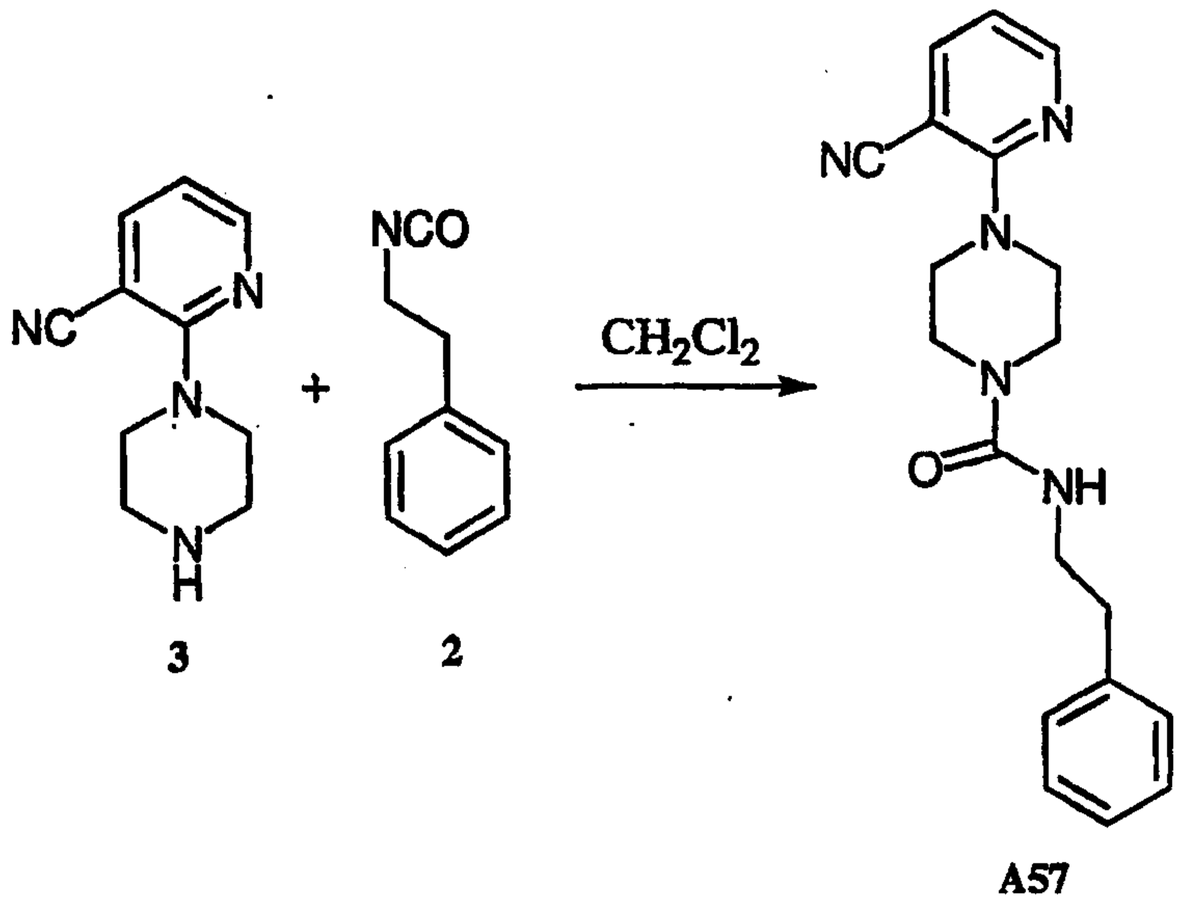
To a solution of 0.1 g (0.43 mmol) of compound **1** (commercially available from Maybridge Chemical Company Ltd., UK) in DCM (5 mL) was added 0.063 g (0.43 mmol) of phenethylisocyanate **2** (commercially available from Sigma-Aldrich, St. Louis, MO and the resulting reaction mixture was stirred for about 4 h. at about 25°C. The solvent was removed under reduced pressure to provide a residue that was purified using a silica gel column eluted with a gradient of 20:80 ethyl acetate:hexane to 50:50 ethyl acetate:hexane to provide 3-substituted Pyridyl Compound **A19** as a white solid (140 mg, 86% yield).

The identity of Compound **A19** was confirmed using ^{1}H-NMR spectroscopy and mass spectrometry (MS).

Compound **A19**: ^{1}H-NMR (400 MHz, CD_3OD): δ 2.85(t, 2H), 3.32 (bm, 4H), 3.52-3.65 (m, 6H), 4.55 (bs, 1H), 7.05 (t, 1H), 7.21 (bm, 3H), 7.63 (t, 2H), 7.93 (t, 1H), 8.49 (d, 1H).

MS (EI): m/z 378 (m+1).

5.2 EXAMPLE 2: SYNTHESIS OF COMPOUND A57



A57

To a solution of 0.1 g (0.53 mmol) of compound **3** in DCM (5 mL) was added 0.078 g (0.53 mmol) of phenethylisocyanate **2** (commercially available from Sigma-Aldrich, St. Louis, MO) and the resulting reaction mixture was stirred for about 4 h. at about 25°C. The solvent was removed under reduced pressure to provide a residue that was purified using a silica gel column eluted with a gradient of 20:80 ethyl acetate:hexane to 50:50 ethyl acetate:hexane to provide 3-substituted Pyridyl Compound **A57** as a white solid (150 mg, 84% yield).

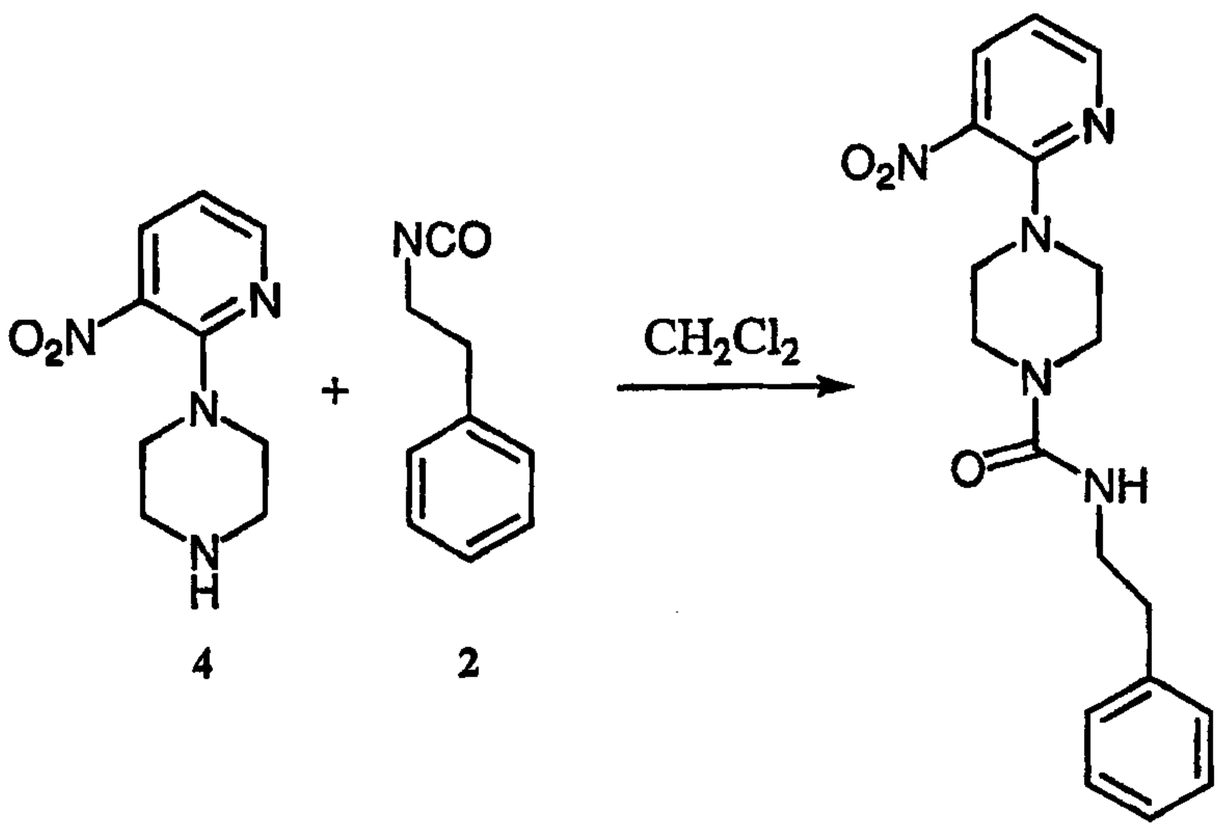
Compound **3** was obtained by dissolving 5 g of 2-chloro-3-cyano-pyridine (commercially available from Sigma-Aldrich, St. Louis, MO
6.21 g of piperazine (72.16 mmol) (commercially available from Sigma-Aldrich, St. Louis, MO and 1.25 mL (72.16 mmol) of DIEA in DMF and allowing the resulting reaction mixture to stir for about 15 h. Water and ethyl acetate were then added to the reaction mixture, the aqueous and organic phases separated, and the aqueous phase was extracted twice with ethyl acetate. The combined ethyl acetate layers were then washed with water, washed with brine, dried (Na_2SO_4), and the solvent was removed under reduced pressure to provide a residue. The residue was purified using a silica gel column to provide compound **3** (5.5 g, 81%).

The identity of Compound **A57** was confirmed using ^{1}H-NMR spectroscopy and mass spectrometry.

Compound **A57**: ^{1}H-NMR (400 MHz, CD_3OD): δ 2.85(t, 2H), 3.52 (bm, 6H), 3.75 (m, 4H), 4.55 (bs, 1H), 6.71 (t, 1H), 7.17-7.35 (bm, 5H), 7.70 (t, 1H), 8.49 (d, 1H).

MS (EI): m/z 335 (m+1).

5.3 EXAMPLE 3: SYNTHESIS OF COMPOUND A38



4 2

A38

To a solution of 0.1 g (0.48 mmol) of compound **4** in DCM (5 mL) was added 0.071 g (0.48 mmol) of phenethylisocyanate **2** (commercially available from Sigma-Aldrich, St. Louis, MO and the resulting reaction mixture was stirred for about 4 h. at about 25°C. The solvent was removed under reduced pressure to provide a residue that was purified using a silica gel column eluted with a gradient of 20:80 ethyl acetate:hexane to 50:50 ethyl acetate:hexane to provide 3-substituted Pyridyl Compound **A38** as a white solid (145 mg, 85% yield).

Compound **4** was obtained by dissolving 5 g of 2-chloro-3-nitro-pyridine (commercially available from Sigma-Aldrich, St. Louis, MO 8 g of piperazine (94.5 mmol) (commercially available from Sigma-Aldrich, St. Louis, MO (and 12.21 mL (94.5 mmol) of DIEA in DMF and allowing the resulting reaction mixture to stir for about 15 h. Water and ethyl acetate were then added to the reaction mixture, the aqueous and organic phases separated, and the aqueous phase was extracted twice with ethyl acetate. The combined ethyl acetate

layers were then washed with water, washed with brine, dried (Na_2SO_4), and the solvent was removed under reduced pressure to provide a residue. The residue was purified using a silica gel column to provide compound **4** (5.2 g, 81%).

The identity of Compound **A38** was confirmed using ^{1}H-NMR spectroscopy and mass spectrometry.

Compound **A38**: ^{1}H-NMR (400 MHz, CD_3OD): δ 2.85(t, 2H), 3.42-3.55 (bm, 10H), 4.55 (bs, 1H), 6.75 (t, 1H), 7.15-7.25 (bm, 3H), 7.30-7.42 (bm, 2H), 8.10 (t, 1H), 8.49 (d, 1H).

MS (EI): m/z 355 (m+1).

5.4 EXAMPLE 4: SYNTHESIS OF COMPOUND E19

Compound **E19** was obtained by a method analogous to that described in Example 1.

The identity of Compound **E19** was confirmed using ^{1}H-NMR spectroscopy and mass spectrometry.

Compound **E19**: ^{1}H-NMR (400 MHz, CD_3OD): δ 8.48-8.43 (m, 1H), 7.92-7.87 (m, 1H), 7.07-7.01 (m, 1H), 5.50 (bs, 1H), 4.50 (bs, 1H), 3.54-3.45 (m, 4H), 3.37-3.25 (m, 6H), 2.21-2.13 (m, 2H), 2.06-1.91 (m, 4H), 1.70-1.52 (m, 4H).

MS (EI): m/z = 383.3.

5.5 EXAMPLE 5: SYNTHESIS OF COMPOUND I19

Compound **I19** was obtained by a method analogous to that described in Example 1.

The identity of Compound **I19** was confirmed using ^{1}H-NMR spectroscopy and mass spectrometry.

Compound **I19**: ^{1}H-NMR (400 MHz, CD_3OD): δ 8.47-8.44 (m, 1H), 7.93-7.88 (m, 1H), 7.02-7.01 (m, 1H), 4.43 (bs, 1H), 3.56-3.49 (m, 4H), 3.37-3.25 (m, 6H), 1.78-1.62 (m, 6H), 1.47-1.40 (m, 2H), 1.38-1.10 (m, 4H), 1.01-0.88 (m, 2H).

MS (EI): m/z = 385.2.

5.6 EXAMPLE 6: BINDING OF 3-SUBSTITUTED PYRIDYL COMPOUNDS TO MGLUR5

The following assay can be used to demonstrate that 3-substituted Pyridyl Compounds bind to mGluR5 and, accordingly, are useful for treating or preventing, *e.g.*, pain.

Cell cultures: Primary glial cultures are prepared from cortices of Sprague-Dawley 18 days old embryos. The cortices are dissected and then dissociated by trituration. The resulting cell homogenate is plated onto poly-D-lysine precoated T175 flasks (BIOCOAT,* commercially available from Becton Dickinson and Company Inc. of Franklin Lakes, NJ) in Dulbecco's Modified Eagle's Medium ("DMEM," pH 7.4), buffered with 25 mM HEPES, and supplemented with 15% fetal calf serum ("FCS," commercially available from Hyclone Laboratories Inc. of Omaha, NE), and incubated at 37°C and 5% CO_2. After 24 hours, FCS supplementation is reduced to 10%. On day six, oligodendrocytes and microglia are removed by strongly tapping the sides of the flasks. One day following this purification step, secondary astrocyte cultures are established by subplating onto 96 poly-D-lysine precoated T175 flasks (BIOCOAT*[1]) at a density of 65,000 cells/well in DMEM and 10% FCS. After 24 hours, the astrocytes are washed with serum free medium and then cultured in DMEM, without glutamate, supplemented with 0.5% FCS, 20 mM HEPES, 10 ng/mL epidermal growth factor ("EGF"), 1 mM sodium pyruvate, and 1X penicillin/streptomycin at pH 7.5 for 3 to 5 days at 37°C and 5% CO_2. The procedure allows the expression of the mGluR5 receptor by astrocytes, as demonstrated by S. Miller *et al.*, *J. Neuroscience* 15(9):6103-6109 (1995).

Assay Protocol: After 3-5 days incubation with EGF, the astrocytes are washed with 127 mM NaCl, 5 mM KCl, 2 mM $MgCl_2$, 700 mM NaH_2PO_4, 2 mM $CaCl_2$, 5 mM $NaHCO_3$, 8 mM HEPES, 10 mM Glucose at pH 7.4 ("Assay Buffer") and loaded with the dye Fluo-4 (commercially available from Molecular Probes Inc. of Eugene, OR) using 0.1 mL of Assay Buffer containing Fluo-4*[2] (3 mM final). After 90 minutes of dye loading, the cells are then washed twice with 0.2 mL Assay Buffer and resuspended in 0.1 mL of Assay Buffer. The plates containing the astrocytes are then transferred to a Fluorometric Imaging Plate reader ("FLIPR," commercially available from Molecular Devices Corporation of Sunnyvale, CA) for the assessment of calcium mobilization flux in the presence of glutamate and in the presence or absence of antagonist. After monitoring fluorescence for 15 seconds to establish a baseline, DMSO solutions

1* now trademark of Collaborative Research, Inc., for biological coatings
2* Trademark of Molecular Probes Inc. for dyes

containing various concentrations of a 3-substituted Pyridyl Compound diluted in Assay Buffer (0.05 mL of 4X dilutions for competition curves) are added to the cell plate and fluorescence is monitored for 2 minutes. 0.05 mL of a 4X glutamate solution (agonist) is then added to each well to provide a final glutamate concentration in each well of 10 mM. Plate fluorescence is then monitored for an additional 60 seconds after agonist addition. The final DMSO concentration in the assay is 1.0%. In each experiment, fluorescence is monitored as a function of time and the data analyzed using Microsoft Excel and GraphPad Prism. Dose-response curves are fit using a non-linear regression to determine the IC_{50} value. In each experiment, each data point is determined two times.

5.7 EXAMPLE 7: IN VIVO ASSAYS FOR PREVENTION OR TREATMENT OF PAIN

Test Animals: Each experiment uses rats weighing between 200-260 g at the start of the experiment. The rats are group-housed and have free access to food and water at all times, except prior to oral administration of a 3-substituted Pyridyl Compound when food is removed for 16 hours before dosing. A control group acts as a comparison to rats treated with a 3-substituted Pyridyl Compound. The control group is administered the carrier for the 3-substituted Pyridyl Compound. The volume of carrier administered to the control group is the same as the volume of carrier and 3-substituted Pyridyl Compound administered to the test group.

Acute Pain: To assess the actions of the 3-substituted Pyridyl Compounds for the treatment or prevention of acute pain the rat tail flick test can be used. Rats are gently restrained by hand and the tail exposed to a focused beam of radiant heat at a point 5 cm from the tip using a tail flick unit (Model 7360, commercially available from Ugo Basile of Italy). Tail flick latencies are defined as the interval between the onset of the thermal stimulus and the flick of the tail. Animals not responding within 20 seconds are removed from the tail flick unit and assigned a withdrawal latency of 20 seconds. Tail flick latencies are measured immediately before (pre-treatment) and 1, 3, and 5 hours following administration of a 3-substituted Pyridyl Compound. Data are expressed as tail flick latency(s) and the percentage of the maximal possible effect (% MPE), *i.e.*, 20 seconds, is calculated as follows:

$$\% \text{ MPE} = \frac{[\text{ (post administration latency) - (pre-administration latency) }]}{\text{(20 s pre-administration latency)}} \times 100$$

The rat tail flick test is described in F.E. D'Amour *et al.*, "A Method for Determining Loss of Pain Sensation," *J. Pharmacol. Exp. Ther.* 72:74-79 (1941).

Acute pain can also be assessed by measuring the animal's response to noxious mechanical stimuli by determining the paw withdrawal threshold ("PWT"), as described below.

Inflammatory Pain: To assess the actions of the 3-substituted Pyridyl Compounds for the treatment or prevention of inflammatory pain the Freund's complete adjuvant ("FCA") model of inflammatory pain is used. FCA-induced inflammation of the rat hind paw is associated with the development of persistent inflammatory mechanical hyperalgesia and provides reliable prediction of the anti-hyperalgesic action of clinically useful analgesic drugs (L. Bartho *et al.*, "Involvement of Capsaicin-sensitive Neurones in Hyperalgesia and Enhanced Opioid Antinociception in Inflammation," *Naunyn-Schmiedeberg's Archives of Pharmacol.* 342:666-670 (1990)). The left hind paw of each animal is administered a 50 µL intraplantar injection of 50% FCA. 24 hour post injection, the animal is assessed for response to noxious mechanical stimuli by determining the PWT, as described below. Rats are then administered a single injection of 1, 3, 10 or 30 mg/Kg of either a 3-substituted Pyridyl Compound; 30 mg/Kg of a control selected from Celebrex, indomethacin or naproxen; or carrier. Responses to noxious mechanical stimuli are then determined 1, 3, 5 and 24 hours post administration. Percentage reversal of hyperalgesia for each animal is defined as:

$$\% \text{ Reversal} = \frac{[\text{ (post administration PWT) - (pre-administration PWT) }]}{[\text{ (baseline PWT) - (pre-administration PWT) }]} \times 100$$

Neuropathic Pain: To assess the actions of the 3-substituted Pyridyl Compounds for the treatment or prevention of neuropathic pain either the Seltzer model or the Chung model can be used.

In the Seltzer model, the partial sciatic nerve ligation model of neuropathic pain is used to produce neuropathic hyperalgesia in rats (Z. Seltzer *et al.*, "A Novel Behavioral Model of Neuropathic Pain Disorders Produced in Rats by Partial Sciatic Nerve Injury," *Pain* 43:205-218 (1990)). Partial ligation of the left sciatic nerve is performed under isoflurane/O_2 inhalation anaesthesia. Following induction of anesthesia, the left thigh of the rat is shaved and the sciatic nerve exposed at high thigh level through a small incision and is carefully cleared of surrounding connective tissues at a site near the trocanther just distal to the point at which the posterior biceps semitendinosus nerve branches off of the common sciatic nerve. A 7-0 silk suture is inserted into the nerve with a 3/8 curved, reversed-cutting mini-needle and tightly ligated so that the dorsal 1/3 to ½ of the nerve thickness is held within the ligature. The wound is closed with a single muscle suture (4-0 nylon (Vicryl)*) and vetbond tissue glue. Following surgery, the wound area is dusted with antibiotic powder. Sham-treated rats undergo an identical surgical procedure except that the sciatic nerve is not manipulated. Following surgery, animals are weighed and placed on a warm pad until they recover from anesthesia. Animals are then returned to their home cages until behavioral testing begins. The animal is assessed for response to noxious mechanical stimuli by determining PWT, as described below, prior to surgery (baseline), then immediately prior to and 1, 3, and 5 hours after drug administration for rear paw of the animal. Percentage reversal of neuropathic hyperalgesia is defined as:

$$\% \text{ Reversal} = \frac{[\text{ (post administration PWT) - (pre-administration PWT) }]}{[\text{ (baseline PWT) - (pre-administration PWT) }]} \times 100$$

In the Chung model, the spinal nerve ligation model of neuropathic pain is used to produce mechanical hyperalgesia, thermal hyperalgesia and tactile allodynia in rats. Surgery is performed under isoflurane/O_2 inhalation anaesthesia. Following induction of anaesthesia a 3 cm incision is made and the left paraspinal muscles are separated from the spinous process at the L_4 - S_2 levels. The L_6 transverse process is carefully removed with a pair of small rongeurs to identify visually the L_4 - L_6 spinal nerves. The left L_5 (or L_5 and L_6) spinal nerve(s) is isolated and tightly ligated with silk thread. A complete hemostasis is confirmed and the wound is sutured using non-absorbable sutures, such as nylon sutures or stainless steel staples. Sham-treated rats undergo an identical surgical

* trademark of Johnson & Johnson Copr for surgical mesh

procedure except that the spinal nerve(s) is not manipulated. Following surgery animals are weighed, administered a subcutaneous (s.c.) injection of saline or ringers lactate, the wound area is dusted with antibiotic powder and they are kept on a warm pad until they recover from the anesthesia. Animals are then be returned to their home cages until behavioral testing begins. The animals are assessed for response to noxious mechanical stimuli by determining PWT, as described below, prior to surgery (baseline), then immediately prior to and 1, 3, and 5 hours after being administered a 3-substituted Pyridyl Compound for the left rear paw of the animal. The animal can also be assessed for response to noxious thermal stimuli or for tactile allodynia, as described below. The Chung model for neuropathic pain is described in S.H. Kim, "An Experimental Model for Peripheral Neuropathy Produced by Segmental Spinal Nerve Ligation in the Rat," *Pain* 50(3):355-363 (1992).

Response to Mechanical Stimuli as an Assessment of Mechanical Hyperalgesia: The paw pressure assay can be used to assess mechanical hyperalgesia. For this assay, hind paw withdrawal thresholds (PWT) to a noxious mechanical stimulus are determined using an analgesymeter (Model 7200, commercially available from Ugo Basile of Italy) as described in C. Stein, "Unilateral Inflammation of the Hindpaw in Rats as a Model of Prolonged Noxious Stimulation: Alterations in Behavior and Nociceptive Thresholds," *Pharmacol. Biochem. and Behavior* 31:451-455 (1988). The maximum weight that can be applied to the hind paw is set at 250 g and the end point is taken as complete withdrawal of the paw. PWT is determined once for each rat at each time point and only the affected (ipsilateral) paw is tested.

Response to Thermal Stimuli as an Assessment of Thermal Hyperalgesia: The plantar test can be used to assess thermal hyperalgesia. For this test, hind paw withdrawal latencies to a noxious thermal stimulus are determined using a plantar test apparatus (commercially available from Ugo Basile of Italy) following the technique described by K. Hargreaves *et al.*, "A New and Sensitive Method for Measuring Thermal Nociception in Cutaneous Hyperalgesia," *Pain* 32(1):77-88 (1988). The maximum exposure time is set at 32 seconds to avoid tissue damage and any directed paw withdrawal from the heat source is taken as the end point. Three latencies are determined at each time point and averaged. Only the affected (ipsilateral) paw is tested.

Assessment of Tactile Allodynia: To assess tactile allodynia, rats are placed in clear, plexiglass compartments with a wire mesh floor and allowed to habituate for a

period of at least 15 minutes. After habituation, a series of von Frey monofilaments are presented to the plantar surface of the left (operated) foot of each rat. The series of von Frey monofilaments consists of six monofilaments of increasing diameter, with the smallest diameter fiber presented first. Five trials are conducted with each filament with each trial separated by approximately 2 minutes. Each presentation lasts for a period of 4-8 seconds or until a nociceptive withdrawal behavior is observed. Flinching, paw withdrawal or licking of the paw are considered nociceptive behavioral responses.

5.8 EXAMPLE 8: IN VIVO ASSAYS FOR PREVENTION OR TREATMENT OF ANXIETY

The elevated plus maze test or the shock-probe burying test can be used to assess the anxiolytic activity of 3-substituted Pyridyl Compounds in rats or mice.

The Elevated Plus Maze Test: The elevated plus maze consists of a platform with 4 arms, two open and two closed (50x10x50 cm enclosed with an open roof). Rats (or mice) are placed in the center of the platform, at the crossroad of the 4 arms, facing one of the closed arms. Time spent in the open arms vs the closed arms and number of open arm entries during the testing period are recorded. This test is conducted prior to drug administration and again after drug administration. Test results are expressed as the mean time spent in open arms and the mean number of entries into open arms. Known anxiolytic drugs increase both the time spent in open arms and number of open arm entries. The elevated plus maze test is described in D. Treit, "Animal Models for the Study of Anti-anxiety Agents: A Review," *Neuroscience & Biobehavioral Reviews* 9(2):203-222 (1985).

The Shock-Probe Burying Test: For the shock-probe burying test the testing apparatus consists of a plexiglass box measuring 40x30x40 cm, evenly covered with approximately 5 cm of bedding material (odor absorbent kitty litter) with a small hole in one end through which a shock probe (6.5 cm long and 0.5 cm in diameter) is inserted. The plexiglass shock probe is helically wrapped with two copper wires through which an electric current is administered. The current is set at 2 mA. Rats are habituated to the testing apparatus for 30 min on 4 consecutive days without the shock probe in the box. On test day, rats are placed in one corner of the test chamber following drug administration. The probe is not electrified until the rat touches it with its snout or fore paws, at which point the rat receives a brief 2 mA shock. The 15 min testing period

begins once the rat receives its first shock and the probe remains electrified for the remainder of the testing period. The shock elicits burying behavior by the rat. Following the first shock, the duration of time the rat spends spraying bedding material toward or over the probe with its snout or fore paws (burying behavior) is measured as well as the number of contact-induced shocks the rat receives from the probe. Known anxiolytic drugs reduce the amount of burying behavior. In addition, an index of the rat's reactivity to each shock is scored on a 4 point scale. The total time spent immobile during the 15 min testing period is used as an index of general activity. The shock-probe burying test is described in D. Treit, 1985, *supra*.

5.9 EXAMPLE 9: *IN VIVO* ASSAYS FOR PREVENTION OR TREATMENT OF AN ADDICTIVE DISORDER

The conditioned place preference test or drug self-administration test can be used to assess the ability of 3-substituted Pyridyl Compounds to attenuate the rewarding properties of known drugs of abuse.

The Conditioned Place Preference Test: The apparatus for the conditioned place preference test consists of two large compartments (45 x 45 x 30 cm) made of wood with a plexiglass front wall. These two large compartments are distinctly different. Doors at the back of each large compartment lead to a smaller box (36 x 18 x 20 cm) box made of wood, painted grey, with a ceiling of wire mesh. The two large compartments differ in terms of shading (white vs black), level of illumination (the plexiglass door of the white compartment is covered with aluminum foil except for a window of 7 x 7 cm), texture (the white compartment has a 3 cm thick floor board (40 x 40 cm) with nine equally spaced 5 cm diameter holes and the black has a wire mesh floor), and olfactory cues (saline in the white compartment and 1 mL of 10% acetic acid in the black compartment). On habituation and testing days, the doors to the small box remain open, giving the rat free access to both large compartments.

The first session that a rat is placed in the apparatus is a habituation session and entrances to the smaller grey compartment remain open giving the rat free access to both large compartments. During habituation, rats generally show no preference for either compartment. Following habituation, rats are given 6 conditioning sessions. Rats are divided into 4 groups: carrier pre-treatment + carrier (control group), 3-substituted Pyridyl Compound pre-treatment + carrier, carrier pre-treatment + morphine,

3-substituted Pyridyl Compound pre-treatment + morphine. During each conditioning session the rat is injected with one of the drug combinations and confined to one compartment for 30 min. On the following day, the rat receives a carrier + carrier treatment and is confined to the other large compartment. Each rat receives three conditioning sessions consisting of 3 drug combination-compartment and 3 carrier-compartment pairings. The order of injections and the drug/compartment pairings are counterbalanced within groups. On the test day, rats are injected prior to testing (30 min to 1 hour) with either morphine or carrier and the rat is placed in the apparatus, the doors to the grey compartment remain open and the rat is allowed to explore the entire apparatus for 20 min. The time spent in each compartment is recorded. Known drugs of abuse increase the time spent in the drug-paired compartment during the testing session. If the 3-substituted Pyridyl Compound blocks the acquisition of morphine conditioned place preference (reward), there will be no difference in time spent in each side in rats pre-treated with a 3-substituted Pyridyl Compound and the group will not be different from the group of rats that was given carrier + carrier in both compartments. Data will be analyzed as time spent in each compartment (drug combination-paired vs carrier-paired). Generally, the experiment is repeated with a minimum of 3 doses of a 3-substituted Pyridyl Compound.

The Drug Self-Administration Test: The apparatus for the drug self-administration test is a standard commercially available operant conditioning chamber. Before drug trials begin rats are trained to press a lever for a food reward. After stable lever pressing behavior is acquired, rats are tested for acquisition of lever pressing for drug reward. Rats are implanted with chronically indwelling jugular catheters for i.v. administration of compounds and are allowed to recover for 7 days before training begins. Experimental sessions are conducted daily for 5 days in 3 hour sessions. Rats are trained to self-administer a known drug of abuse, such as morphine. Rats are then presented with two levers, an "active" lever and an "inactive" lever. Pressing of the active lever results in drug infusion on a fixed ratio 1 (FR1) schedule (*i.e.*, one lever press gives an infusion) followed by a 20 second time out period (signaled by illumination of a light above the levers). Pressing of the inactive lever results in infusion of excipient. Training continues until the total number of morphine infusions stabilizes to within ± 10% per session. Trained rats are then used to evaluate the effect of 3-substituted Pyridyl Compounds pre-treatment on drug self-administration. On test day,

rats are pre-treated with a 3-substituted Pyridyl Compound or excipient and then are allowed to self-administer drug as usual. If the 3-substituted Pyridyl Compound blocks the rewarding effects of morphine, rats pre-treated with the 3-substituted Pyridyl Compound will show a lower rate of responding compared to their previous rate of responding and compared to excipient pre-treated rats. Data is analyzed as the change in number of drug infusions per testing session (number of infusions during test session - number of infusions during training session).

5.10 EXAMPLE 10: FUNCTIONAL ASSAY FOR CHARACTERIZING mGLUR1 ANTAGONISTIC PROPERTIES

Functional assays for the characterization of mGluR 1 antagonistic properties are known in the art. For example, the following procedure can be used.

A CHO-rat mGluR1 cell line is generated using cDNA encoding rat mGluR1 receptor (M. Masu and S. Nakanishi, *Nature* 349:760-765 (1991)). The cDNA encoding rat mGluR1 receptor can be obtained from, *e.g.*, Prof. S. Nakanishi (Kyoto, Japan).

40,000 CHO-rat mGluR1 cells/well are plated into a COSTAR 3409, black, clear bottom, 96 well, tissue culture treated plate (commercially available from Fisher Scientific of Chicago, IL) and are incubated in Dulbecco's Modified Eagle's Medium (DMEM, pH 7.4) supplemented with glutamine, 10% FBS, 1% Pen/Strep, and 500 μg/mL Geneticin for about 12 h. The CHO-rat mGluR1 cells are then washed and treated with OPTIMEM medium (commercially available from Invitrogen, Carlsbad, CA) and incubated for a time period ranging from 1 to 4 hours prior to loading the cells with the dye FLUO-4 (commercially available from Molecular Probes Inc., Eugene, OR). After incubation, the cell plates are washed with loading buffer (127 mM NaCl, 5 mM KCl, 2 mM $MgCl_2$, 700 μM, NaH_2PO_4, 2 mM $CaCl_2$, 5 mM$NaHCO_3$, 8 mM HEPES, and 10 mM glucose, pH 7.4) and incubated with 3 μM FLUO-4 in 0.1 mL loading buffer for 90 min. The cells are then washed twice with 0.2 mL loading buffer, resuspended in 0.1 mL of loading buffer, and transferred to a FLIPR for measurement of calcium mobilization flux in the presence of glutamate and in the presence or absence of a 3-substituted Pyridyl Compound.

To measure calcium mobilization flux, fluoresence is monitored for about 15 s to establish a baseline and DMSO solutions containing various concentrations of a 3-substituted Pyridyl Compound ranging from about 50 μM to about 0.8 nM diluted in

loading buffer (0.05 mL of a 4X dilution) are added to the cell plate and fluoresence is monitored for about 2 min. 0.05 mL of a 4X glutamate solution (agonist) is then added to each well to provide a final glutamate concentration in each well of 10 μM and fluoresence is monitored for about 1 additional min. The final DMSO concentration in the assay is 1%. In each experiment fluoresence is monitored as a function of time and the data is analyzed using a non-linear regression to determine the IC_{50} value. In each experiment each data point is determined twice.

5.11 EXAMPLE 11: BINDING OF 3-SUBSTITUTED PYRIDYL COMPOUNDS TO VR1

Methods for assaying compounds capable of inhibiting VR1 are known to those skilled in the art, for example, those methods disclosed in U.S. Patent No. 6,239,267 to Duckworth *et al.*; U.S. Patent No. 6,406,908 to McIntyre *et al.*; or U.S. Patent No. 6,335,180 to Julius *et al.* The results of these assays will demonstrate that 3-substituted Pyridyl Compounds bind to and modulate the activity of VR1.

Binding of Compound **A19** to VR1: Assay Protocol

Human VR1 Cloning: Human spinal cord RNA (commercially available from Clontech, Palo Alto, CA) was used. Reverse transcription was conducted on 1.0 μg total RNA using Thermoscript Reverse Transcriptase (commercially available from Invitrogen, Carlsbad, CA) and oligo dT primers as detailed in its product description. Reverse transcription reactions were incubated at 55°C for 1 h, heat-inactivated at 85°C for 5 min, and RNase H-treated at 37°C for 20 min.

Human VR1 cDNA sequence was obtained by comparison of the human genomic sequence, prior to annotation, to the published rat sequence. Intron sequences were removed and flanking exonic sequences were joined to generate the hypothetical human cDNA. Primers flanking the coding region of human VR1 were designed as follows: forward primer, GAAGATCTTCGCTGGTTGCACACTGGGCCACA; and reverse primer, GAAGATCTTCGGGGACAGTGACGGTTGGATGT.

PCR of VR1 was performed on one tenth of the Reverse transcription reaction mixture using Expand Long Template Polymerase and Expand Buffer 2 in a final volume of 50 μL according to the manufacturer's instructions (Roche Applied Sciences, Indianapolis, IN). After denaturation at 94°C for 2 min PCR amplification was performed for 25 cycles at 94°C for 15 sec, 58°C for 30 sec, and 68°C for 3 min followed by a final incubation at 72°C for 7 min to complete the amplification. A PCR

product of ~2.8 kb was gel-isolated using a 1.0% agarose, Tris-Acetate gel containing 1.6 μg/mL of crystal violet and purified with a S.N.A.P. UV-Free Gel Purification Kit (commercially available from Invitrogen). The VR1 PCR product was cloned into the pIND/V5-His-TOPO vector (commercially available from Invitrogen) according to the manufacturer's instructions. DNA preparations, restriction enzyme digestions, and preliminary DNA sequencing were performed according to standard protocols. Full-length sequencing confirmed the identity of the human VR1.

Generation of Inducible Cell Lines: Unless noted otherwise, cell culture reagents were purchased from Life Technologies of Rockville, MD. HEK293-EcR cells expressing the ecdysone receptor (commercially available from Invitrogen) were cultured in Growth Medium (Dulbecco's Modified Eagles Medium containing 10% fetal bovine serum (commercially available from HYCLONE, Logan, UT), lx penicillin/streptomycin, lx glutamine, 1 mM sodium pyruvate and 400 μg/mL Zeocin (commercially available from Invitrogen)). The VR1-pIND constructs were transfected into the HEK293-EcR cell line using Fugene transfection reagent (commercially available from Roche Applied Sciences, Basel, Switzerland). After 48 h, cells were transferred to Selection Medium (Growth Medium containing 300 μg/mL G418 (commercially available from Invitrogen)). Approximately 3 weeks later individual Zeocin/G418 resistant colonies were isolated and expanded. To identify functional clones, multiple colonies were plated into 96-well plates and expression was induced for 48 h using Selection Medium supplemented with 5 μM ponasterone A ("PonA") (commercially available from Invitrogen). On the day of assay, cells were loaded with Fluo-4 (a calcium-sensitive dye that is commercially available from Molecular Probes, Eugene, OR) and CAP-mediated calcium influx was measured using a FLIPR as described below. Functional clones were re-assayed, expanded, and cryopreserved.

pH-Based Assay: Two days prior to performing this assay, cells were seeded on poly-D-lysine-coated 96-well clear-bottom black plates (commercially available from Becton-Dickinson) at 75,000 cells/well in growth media containing 5 μM PonA (commercially available from Invitrogen) to induce expression. On the day of the assay, the plates were washed with 0.2 mL 1x Hank's Balanced Salt Solution (commercially available from Life Technologies) containing 1.6 mM $CaCl_2$ and 20 mM HEPES, pH 7.4 ("wash buffer"), and loaded using 0.1 mL of wash buffer containing Fluo-4 (3 μM final concentration, commercially available from Molecular Probes). After 1 h, the cells were

washed twice with 0.2 mL wash buffer and resuspended in 0.05 mL 1x Hank's Balanced Salt Solution (commercially available from Life Technologies) containing 3.5 mM $CaCl_2$ and 10 mM Citrate, pH 7.4 ("assay buffer"). Plates were then transferred to a FLIPR (commercially available from Molecular Devices) for assay. Compound **A19** was diluted in assay buffer, and 50 mL of the resultant solution were added to the cell plates and the solution monitored for two minutes. The final concentration of Compound **A19** ranged from about 50 pM to about 3 μM. Agonist buffer (wash buffer titrated with 1N HCl to provide a solution having a pH of 5.5 when mixed 1:1 with assay buffer) (0.1 mL) was then added to each well, and the plates were incubated for 1 additional minute. Data were collected over the entire time course and analyzed using Excel and Graph Pad Prism. Compound **A19** when assayed according to this protocol had an IC_{50} of 808.2 ± 253.7 nM (n = 5).

Capsaicin-based Assay: Two days prior to performing this assay, cells were seeded in poly-D-lysine-coated 96-well clear-bottom black plates (50,000 cells/well) in growth media containing 5 μM PonA (commercially available from Invitrogen) to induce expression. On the day of the assay, the plates were washed with 0.2 mL 1x Hank's Balanced Salt Solution (commercially available from Life Technologies) containing 1 mM $CaCl_2$ and 20 mM HEPES, pH 7.4, and cells were loaded using 0.1 mL of wash buffer containing Fluo-4 (3 μM final). After one hour, the cells were washed twice with 0.2 mL of wash buffer and resuspended in 0.1 mL of wash buffer. The plates were transferred to a FLIPR (commercially available from Molecular Devices) for assay. 50 μL of Compound **A19** diluted with assay buffer were added to the cell plates and incubated for 2 min. The final concentration of Compound **A19** ranged from about 50 pM to about 3 μM. Human VR1 was activated by the addition of 50 μL of capsaicin (400 nM), and the plates were incubated for an additional 3 min. Data were collected over the entire time course and analyzed using Excel and GraphPad Prism. Compound **A19** when assayed according to this protocol had an IC_{50} of 382 ± 64.2 nM (n = 3).

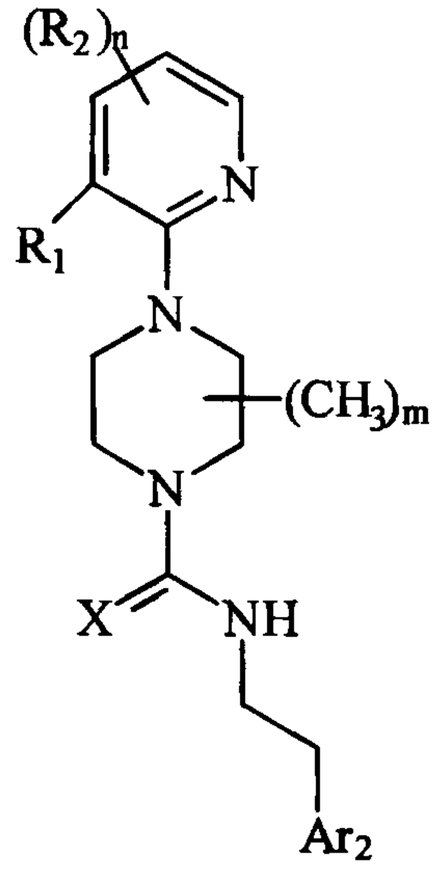
The results of the pH-based assay and the capsaicin-based assay demonstrate that Compound **A19**, an illustrative 3-substituted Pyridyl Compound, binds to and modulates the activity of human VR1 and accordingly is useful for treating or preventing pain, UI, an ulcer, IBD, or IBS in an animal.

The present invention is not to be limited in scope by the specific embodiments disclosed in the examples which are intended as illustrations of a few aspects of the

invention and any embodiments that are functionally equivalent are within the scope of this invention. Indeed, various modifications of the invention in addition to those shown and described herein will become apparent to those skilled in the art and are intended to fall within the scope of the appended claims.

What is claimed is:

1. A compound of formula (I):

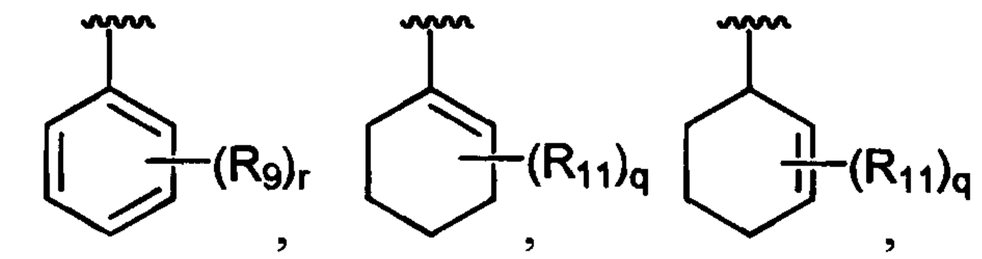


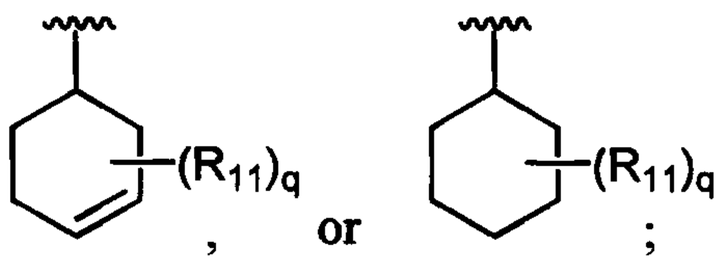
(I)

or a pharmaceutically acceptable salt thereof, wherein:

X is S or O;

Ar_2 is





or

;

R_1 is $-CF_3$, $-NO_2$, or -CN;

each R_2 is independently:

(a) -halo,-CN, -OH, $-NO_2$, or $-NH_2$;

(b) -(C_1-C_{10})alkyl, -(C_2-C_{10})alkenyl, -(C_2-C_{10})alkynyl, -(C_3-C_{10})cycloalkyl, -(C_8-C_{14})bicycloalkyl, -(C_8-C_{14})tricycloalkyl, -(C_5-C_{10})cycloalkenyl, -(C_8-C_{14})bicycloalkenyl, -(C_8-C_{14})tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups; or

(c) -phenyl, -naphthyl, -(C_{14})aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups;

each R_5 is independently -CN, -OH, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -halo, -N_3, -NO_2, -$N(R_7)_2$, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_6 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, -CH_2(halo), -CN, -OH, -halo, -N_3, -NO_2, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_7 is independently -H, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, or -CH_2(halo);

each R_9 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -C(halo)$_3$, -CH(halo)$_2$, or CH_2(halo), -CN, -OH, -halo, -N_3, -NO_2, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_{11} is independently -CN, -OH, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -halo, -N_3, -NO_2, -$N(R_7)_2$, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each halo is independently -F, -Cl, -Br, or -I;

n is an integer ranging from 0 to 3;

m is 0 or 1;

q is an integer ranging from 0 to 6; and

r is an integer ranging from 0 to 5.

2. The compound of claim 1, wherein R_1 is $-CF_3$.

3. The compound of claim 2, wherein

X is O;

m is 0;

n is 0; and

Ar_2 is substituted or unsubstituted phenyl.

4. The compound of claim 3, wherein the Ar_2 phenyl is unsubstituted.

5. The compound of claim 3, wherein the Ar_2 phenyl is substituted at the 4-position.

6. The compound of claim 5, wherein the Ar_2 phenyl is substituted with a $-(C_1-C_6)$ alkyl group, with a $-CF_3$ group, with –Cl, with –Br, with –F, with –I or with $-OCF_3$.

7. The compound of claim 6, wherein the $-(C_1-C_6)$ alkyl group is a *tert*-butyl group or an *iso*-propyl group.

8. The compound of claim 1, wherein R_1 is $-NO_2$.

9. The compound of claim 8, wherein

X is O;

m is 0;

n is 0; and

Ar_2 is substituted or unsubstituted phenyl.

10. The compound of claim 9, wherein the Ar_2 phenyl is unsubstituted.

11. The compound of claim 9, wherein the Ar_2 phenyl is substituted at the 4-position.

12. The compound of claim 11, wherein the Ar_2 phenyl is substituted with a $-(C_1-C_6)$ alkyl group, with a $-CF_3$ group, with –Cl, with –Br, with –F, with –I or with $-OCF_3$.

13. The compound of claim 12, wherein the -(C_1-C_6) alkyl group is a *tert*-butyl group or an *iso*-propyl group.

14. The compound of claim 1, wherein R_1 is -CN.

15. The compound of claim 14, wherein

X is O;

m is 0;

n is 0; and

Ar_2 is substituted or unsubstituted phenyl.

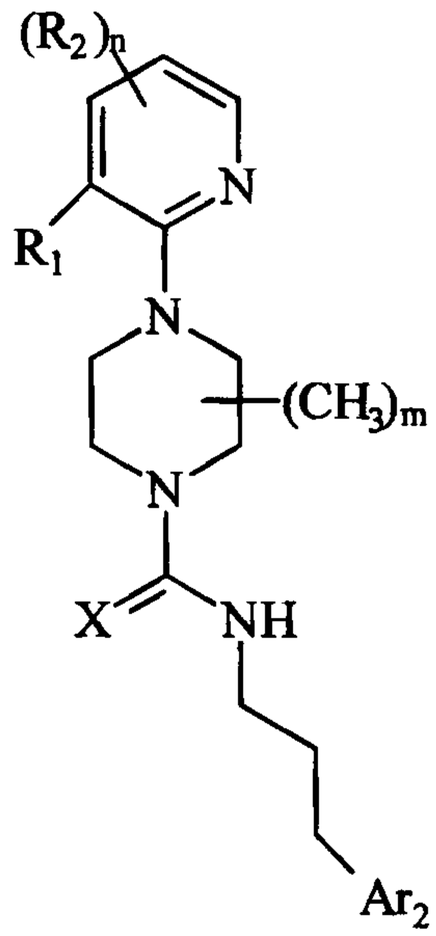
16. The compound of claim 15, wherein the Ar_2 phenyl is unsubstituted.

17. The compound of claim 15, wherein the Ar_2 phenyl is substituted at the 4-position.

18. The compound of claim 17, wherein the Ar_2 phenyl is substituted with a -(C_1-C_6) alkyl group, with a $-CF_3$ group, with –Cl, with –Br, with –F, with –I or with $-OCF_3$.

19. The compound of claim 18, wherein the -(C1-C6) alkyl group is a tert-butyl group or an iso-propyl group.

20. A compound of formula (II):

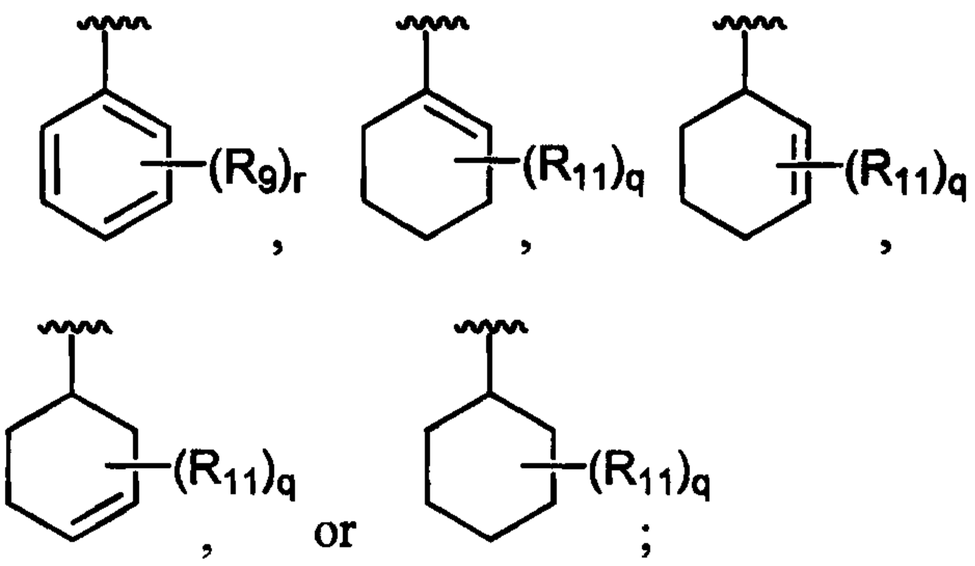


(II)

or a pharmaceutically acceptable salt thereof, wherein:

X is O or S;

Ar_2 is



R_1 is $-CF_3$, $-NO_2$, or -CN;

each R_2 is independently:

(a) -halo,-CN, -OH, $-NO_2$, or $-NH_2$;

(b) -(C_1-C_{10})alkyl, -(C_2-C_{10})alkenyl, -(C_2-C_{10})alkynyl, -(C_3-C_{10})cycloalkyl, -(C_8-C_{14})bicycloalkyl, -(C_8-C_{14})tricycloalkyl, -(C_5-C_{10})cycloalkenyl, -(C_8-C_{14})bicycloalkenyl, -(C_8-C_{14})tricycloalkenyl, -(3- to 7-membered)heterocycle, or -(7- to 10-membered)bicycloheterocycle, each of which is unsubstituted or substituted with one or more R_5 groups; or

(c) -phenyl, -naphthyl, -(C_{14})aryl or -(5- to 10-membered)heteroaryl, each of which is unsubstituted or substituted with one or more R_6 groups;

each R_5 is independently -CN, -OH, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -halo, -N_3, -NO_2, -$N(R_7)_2$, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_6 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, -CH_2(halo), -CN, -OH, -halo, -N_3, -NO_2, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_7 is independently -H, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -(3- to 5-membered)heterocycle, -C(halo)$_3$, -CH(halo)$_2$, or -CH_2(halo);

each R_9 is independently -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -(C_3-C_8)cycloalkyl, -(C_5-C_8)cycloalkenyl, -phenyl, -C(halo)$_3$, -CH(halo)$_2$, or CH_2(halo), -CN, -OH, -halo, -N_3, -NO_2, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each R_{11} is independently -CN, -OH, -(C_1-C_6)alkyl, -(C_2-C_6)alkenyl, -(C_2-C_6)alkynyl, -halo, -N_3, -NO_2, -$N(R_7)_2$, -CH=NR_7, -NR_7OH, -OR_7, -COR_7, -C(O)OR_7, -OC(O)R_7, -OC(O)OR_7, -SR_7, -S(O)R_7, or -$S(O)_2R_7$;

each halo is independently -F, -Cl, -Br, or -I;

n is an integer ranging from 0 to 3;

m is 0 or 1;

q is an integer ranging from 0 to 6; and

r is an integer ranging from 0 to 5.

21. The compound of claim 20, wherein R_1 is $-CF_3$.

22. The compound of claim 21, wherein

X is O;

m is 0;

n is 0; and

Ar_2 is substituted or unsubstituted phenyl.

23. The compound of claim 22, wherein the Ar_2 phenyl is unsubstituted.

24. The compound of claim 22, wherein the Ar_2 phenyl is substituted at the 4-position.

25. The compound of claim 24, wherein the Ar_2 phenyl is substituted with a $-(C_1-C_6)$ alkyl group, with a $-CF_3$ group, with –Cl, with –Br, with –F, with –I or with $-OCF_3$.

26. The compound of claim 25, wherein the $-(C_1-C_6)$ alkyl group is a *tert*-butyl group or an *iso*-propyl group.

27. The compound of claim 20, wherein R_1 is $-NO_2$.

28. The compound of claim 27, wherein

X is O;

m is 0;

n is 0; and

Ar_2 is substituted or unsubstituted phenyl.

29. The compound of claim 28, wherein the Ar_2 phenyl is unsubstituted.

30. The compound of claim 28, wherein the Ar_2 phenyl is substituted at the 4-position.

31. The compound of claim 30, wherein the Ar_2 phenyl is substituted with a $-(C_1-C_6)$ alkyl group, with a $-CF_3$ group, with –Cl, with –Br, with –F, with –I or with $-OCF_3$.

32. The compound of claim 31, wherein the -(C_1-C_6) alkyl group is a *tert*-butyl group or an *iso*-propyl group.

33. The compound of claim 20, wherein R_1 is -CN.

34. The compound of claim 33, wherein

X is O;

m is 0;

n is 0; and

Ar_2 is substituted or unsubstituted phenyl.

35. The compound of claim 34, wherein the Ar_2 phenyl is unsubstituted.

36. The compound of claim 34, wherein the Ar_2 phenyl is substituted at the 4-position.

37. The compound of claim 36, wherein the Ar_2 phenyl is substituted with a -(C_1-C_6) alkyl group, with a $-CF_3$ group, with –Cl, with –Br, with –F, with –I or with $-OCF_3$.

38. The compound of claim 37, wherein the -(C_1-C_6) alkyl group is a *tert*-butyl group or an *iso*-propyl group.

39. A composition comprising the compound of claim 1 or claim 20 or a pharmaceutically acceptable salt thereof and a pharmaceutically acceptable carrier or excipient.

40. Use of a compound of claim 1 or claim 20 or a pharmaceutically acceptable salt thereof in the manufacture of a medicament for treating pain, urinary incontinence, an ulcer, irritable-bowel syndrome or inflammatory bowel disease.

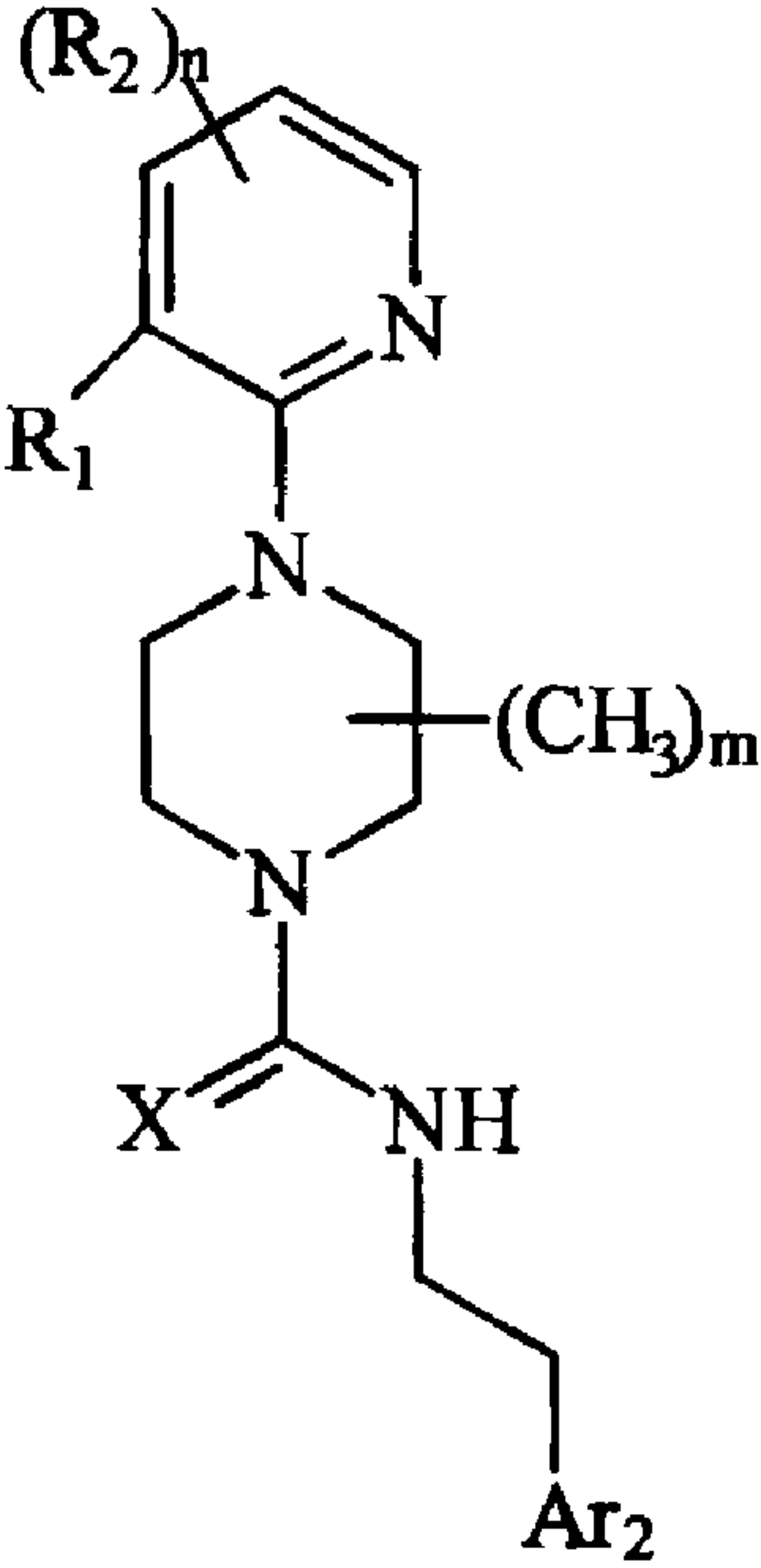
41. A method for inhibiting VR1 function in a cell *in vitro* comprising contacting a cell, capable of expressing VR1 with the compound or a pharmaceutically acceptable salt of the compound of claim 1 or claim 20.

42. A kit comprising:

a container containing the compound, or a pharmaceutically acceptable salt of the compound, of claim 1 or claim 20; and

instructions or a label in association with said container instructing the use of the compound, or a pharmaceutically acceptable salt of the compound, of claim 1 or claim 20 for treating pain, urinary incontinence, an ulcer, irritable-bowel syndrome or inflammatory bowel disease.

43. A method for preparing a composition, comprising the step of admixing a compound or a pharmaceutically acceptable salt of the compound of claim 1 or claim 20 and a pharmaceutically acceptable carrier or excipient.



(I)